Minimum Wages and the Spatial Distribution of Economic Activity*

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Abstract

We provide new evidence on one of the most salient and least studied determinants of migration: the probability of finding a job. We develop a dynamic spatial search-and-matching general equilibrium framework in which people migrate in order to search for work in a different labor market. To bring the model to the data, we use Tanzania's annual census of firms, which is unique among low-income countries for having nationally representative data on vacancies and hiring. We use Tanzania's first minimum wage law, which stipulated different levels across industries, as a natural experiment to isolate the effect of the job finding rate on migration. The minimum wage has two effects: it increases the expected wage for a searching worker and it reduces the profitability of posting a vacancy for a firm, unless there is a sufficiently large increase in the number of searching workers. We find that in some, but not all, net-immigration labor markets employment rose, while employment fell in all net-emigration labor markets. Comparing immigration across labor markets, those that gained population share had neither the highest wages nor the largest gains in wages. Instead, they had the least negative employment effects, indicating that the job finding rate is of first-order importance in choosing where to go. We imposed no curvature on the utility function, suggesting that these estimates are a lower bound on the importance of the job finding rate for migration.

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1 Introduction

Six percent of the world's population lives abroad (UN, 2024), while in many developing countries between 20-25 percent of individuals emigrate from their home town as young adults (Young, 2013). There are many reasons why people may leave home: war, famine, environmental change, or in search of better economic opportunities. But how do they choose where to go? Standard economic theory explains the migration decision through three mechanisms: wages, amenities, and migration costs. Yet, if there are very few jobs, an aesthetically pleasing location with excellent public services and high wages is unlikely to attract many migrants. In this paper, we shed new light on a less explored determinant of migration: the probability of finding a job.

The contribution of this paper is to quantify the importance of the job finding rate on migration. To do so, we use Tanzania's first-ever minimum wage law, which had varying effects on wages and employment across labor markets, as a natural experiment. Our analysis builds on Harris & Todaro (1970), who proposed that minimum wages raise both wages and unemployment in urban areas, and that migration ensues until the expected urban income equates with the low rural income. In the years since that study, many countries in sub-Saharan Africa have adopted minimum wage laws (Bhorat *et al.*, 2017). While their framework is useful in understanding the decision to migrate, our goal is to understand the decision of *where* to migrate.

To shed light on the relationship between finding a job and migration, we develop a search and matching model within a spatial general equilibrium framework. The key novelty in our model is that individuals either search for work in their own labor market or move elsewhere to search for work there. This means that migration is risky, and not all migrants will find a job. Yet, as more workers immigrate to the same labor market, it becomes more profitable for firms to post vacancies because the rising number of workers searching for a job reduces the expected time to fill a vacancy, causing employment to grow endogenously. When workers are matched with a firm, a productivity is realized and a wage is determined via Nash bargaining. Having the option to migrate raises the worker's outside option value, and hence their bargaining power with firms when they are matched with a job.

We extend the model to incorporate the minimum wage policy by adapting Flinn (2006)'s search

and matching framework with a minimum wage. In his model, there is a single labor market, and minimum wages can increase employment by inducing people who are out of the labor force (OLF) to enter the labor force. Our setting differs in three ways. First, there is no unemployment *per se*–workers are either self-employed or employed in a firm. Second, minimum wages change the size of the labor force through migration rather than through workers who are OLF entering. This implies that if workers immigrate to a labor market to search for work, there must be another in which there are now fewer workers searching. Third, we assume that the government only enforces the minimum wage in jobs whose productivity level exceeds the minimum wage.[1]

In the model, the minimum wage shifts the surplus from a job match from the firm to the worker, meaning that the expected value to the firm of posting a vacancy falls, while the expected value for a worker of searching for a job rises. When the bite of the minimum wage (the measure of jobs that are constrained) varies across labor markets, it induces migration by changing the relative value of searching across labor markets. Those in which the minimum wage has more bite become more attractive to search in because the expected match-wage rises, but they also become less attractive because firms post fewer vacancies, which reduces the probability of finding a job. Thus the net effect of the minimum wage on migration is ambiguous. However, when a labor market experiences a net inflow of migrants, the labor market gets tighter, reducing the expected time to fill a vacancy and increasing the value of posting a vacancy. As more and more workers immigrate to the same labor market, rising labor market tightness will eventually more than offset the fall in expected profits and employment will rise.

The context of our empirical analysis is Tanzania, one of the poorest countries in the world with an estimated PPP adjusted GDP per capita of less than $4000 in 2024 (IMF, 2024). To bring the model to the data, we exploit a nationally representative dataset of Tanzanian firms, the Employment and Earnings Survey (EES), which surveys approximately 9,000 firms each year, and includes all firms with at least fifty employees and a representative sample of smaller firms.[2] Critically for this analysis,

[1] Imperfect compliance with the minimum wage is not unique to developing countries (Ashenfelter & Smith, 1979). Limited enforcement may be a rational decision for the government if the aim of the policy is to increase output (Basu *et al.*, 2010) or to limit the negative employment effects in low productivity firms (Marshall, 2025a).

[2] To put this in context, the US establishment survey, JOLTS, surveys 16,000 firms each month (Davis *et al.*, 2013).

the survey began collecting information on vacancy postings, hiring in 2010, making this an unique opportunity to study search and matching in a low-income country. We complement this data with information on migration, population, and employment from the 2012 Census. To quantify the effect of minimum wages, we use Tanzania's first-ever minimum wage law, which was enacted in 2010. The legislation prescribed a specific level for 20 industries and a national floor for all others. Differences in industrial composition and pre-existing wages created variation in the effect of the policy on both wages and employment across space.

We use this data to document two motivating facts. First, we estimate the relationship between the immigration rate and wages, employment and vacancies. We estimate a precise zero relationship between wages and immigration in the cross-section, and this relationship holds when we include controls for the employment rate or the vacancy rate. However, we find a strong positive relationship between immigration and both vacancies and employment. To account for potential endogeneity of wages and employment we develop two instruments: the average minimum wage faced by a firm in each labor market, and a Berry *et al.* (1995) type-instrument that measures the share of workers in each industry in all other labor that were paid below the minimum wage prior to its implementation. In this specification, we estimate that a one percent increase in average wages and the employment rate increase the immigration rate by 0.04 ($p < 0.05$) and 0.23 percent ($p < 0.01$), respectively, indicating that employment is a more important margin for migration than wages. We corroborate these findings by estimating the same relationship among international migrants, finding similar point estimates.

We then turn to the effect of the minimum wage, showing that higher minimum wages are associated with less vacancy posting and less hiring. To do so, we define high minimum wage industries as those for which the applicable minimum wage was at least twice the national floor. In the year before the minimum wage was enacted, the rate of hiring was similar in high and low minimum wage industries. Relative to the low industries, the rate of hiring in high industries fell in 2010, when the minimum wage was enacted, and remained below the low industries until 2015. Although we do not observe vacancies before the minimum wage was implemented, firms in low industries posted vacancies at a higher rate over the entire period.

The data also provides us a unique opportunity to estimate the parameters of the matching function

in a low-income country context. Using data on hires and vacancies between 2010-2014, we estimate a match elasticity of 0.4, which is comparable to the average elasticity in the literature (Petrongolo & Pissarides, 2001). However, our estimates of the matching productivity, while varying across labor markets, are an order of magnitude lower than Shimer (2005)'s estimate for the US, which is consistent with large labor market frictions in development (Abebe *et al.*, 2020). Having estimated the matching function in each labor market, we calibrate the remaining parameters to match the observed distribution of wages and employment across space.

Because we only observe vacancies after the minimum wage was implemented, we compare the equilibrium in the model to the counterfactual without a minimum wage. We find that the minimum wage increased vacancy creation and hence employment in some, but not all, locations that gained population. However, consistent with the model's ambiguous predictions about the net effect of minimum wages, the labor markets that grew in population share are uncorrelated with the average job productivity. We find that the labor markets that grew the most are those in which employment fell the least (or grew), which are also those with the smallest gains in average wages. We imposed no curvature on the utility function in the model, meaning that these estimates are lower-bounds on the importance of employment on migration.

To highlight the mechanisms through which minimum wages affect migration, we compare two counterfactual policies: a single national minimum wage, and local minimum wage set at the same percentile of the wage distribution, where the later aims to capture the ILO recommendation to set minimum wages relative to the cost of living. The model makes the counterintuitive prediction that the national minimum wage induces migration towards more productive labor markets, while the local minimum wage induces migration towards less productive labor markets. This is because the local minimum wage has a similar negative effect on vacancy posting across all labor markets, while the national minimum wage has very little bite in high-productivity labor markets. Because workers are more sensitive to employment than wages, they move in the opposite direction from what one would expect when considering wages in isolation.

How can policy increase employment? While minimum wages may raise employment in some labor markets, on net they reduce employment by shifting surplus from the firm to the worker. In

this context, employment rates are low. Both the empirical and model results indicate that this is not because wages are too low, suggesting that a policy subsidizing hiring costs may raise employment. To investigate this channel, we simulate a policy which subsidizes vacancy posting costs that is financed through a tax on wages. We find that this policy substantially increases both employment and surplus. This suggests that in contexts in which employment rates are low, policies that subsidize firms rather than workers are likely to have the largest employment effects.

This paper contributes to the literature on search and matching across labor markets. Simply put, we bring the single market model of search and matching (Mortensen & Pissarides, 1994) into a spatial equilibrium model (Monte *et al.*, 2018), to study the relationship between migration and job search. While this relationship has been largely overlooked in the development literature, many of the predictions of our model are consistent with findings in high-income countries. In a partial equilibrium setting, Kennan & Walker (2011) find that immigration is driven by differences in mean wages, and that migration happens when the current income realization is low. Baum-Snow & Pavan (2012) show that city-size wage premia is driven both by differences in the wage distribution and returns to experience. Bilal (2023) considers the location decisions of firms, finding that inefficient location decisions by firms enhances cross-sectional unemployment rates. Closely related to this paper, Schmutz & Sidibé (2019) and Heise & Porzio (2022) develop dynamic spatial equilibrium models of search and matching to study the inter-relationship between labor markets in France and Germany, respectively. The critical difference between those papers and ours is that in our model, workers can only search in their own labor market. This largely reflects a difference in context: in low-income countries job search costs rise rapidly with distance (Abebe *et al.*, 2020).[3]

This paper also contributes to the literature on migration in developing countries, which explains migration flows through three mechanisms: wages, amenities, and migration costs. Several authors have highlighted the role of human capital in migrant wages across locations (Young, 2013; Hicks *et al.*, 2021; Bryan & Morten, 2019), while others have highlighted the importance of amenities which may reflect observable characteristics of a location, *e.g.* natural beauty, pollution, public services,

[3]That is not to say that this relationship is not also true in high-income countries: Manning & Petrongolo (2017) find that job applications fall sharply with distance in the UK. However, it is much less likely that workers are actively searching for jobs across many labor markets prior to migrating.

or idiosyncratic tastes (Rosen, 1974; Roback, 1982; Redding & Rossi-Hansberg, 2017; Marshall, 2025b). While these factors are useful in describing immigration, the origin of the migrant also matters through migration costs which may be monetary (Bryan *et al.*, 2014; Imbert & Papp, 2020) or non-monetary (Morten, 2019; Lagakos, 2020; Lagakos *et al.*, 2020) or may reflect migration networks. To explain why some people are emigrating from cities and others are moving to places where wages are lower, high wage labor markets are typically calibrated to have low amenities. Yet along a litany of observable measures, the amenities in cities are better (Gollin *et al.*, 2021). This paper is able to reconcile this contradiction through an additional determinant of migration: the job finding rate.

Finally, this paper contributes to the literature on minimum wages in developing countries by extending Flinn (2006)'s model of search and matching with a minimum wage to a multiple labor market equilibrium. Harris & Todaro (1970) first hypothesized that minimum wages raise both immigration to and unemployment in urban labor markets. Recent empirical evidence from high-income countries has corroborated the prediction about the effect of minimum wages on migration in the US (Monras, 2019) and Germany (Dustmann *et al.*, 2022). However, evidence on the relationship between minimum wages and employment has been more mixed. Studying Brazil, Almeida & Carneiro (2012) and Derenoncourt *et al.* (2021) find no disemployment effects, while Magruder (2013) and Mansoor & O'Neill (2021) find positive employment effects in Indonesia and India, respectively. However, these results may not extend to countries at the bottom of the income distribution (Bhorat *et al.*, 2017; Marshall, 2025a). Our model rationalizes heterogeneous employment effects within the country through migration: employment rises in some labor markets that gain population because more workers are searching.

2 Data

The main source of data for this analysis is the Tanzanian Employment and Earnings Survey (EES), an annual census of firms conducted by the Bureau of Labor Statistics to construct national statistics on wages and employment. The survey has been conducted in most years since 2005, and includes all firms with at least fifty employees and a sample of smaller firms. To the best of our knowledge, this

survey is unique in the sub-Saharan Africa context in that it covers the entire country rather than just urban areas. The survey collects information on the total wage-bill, total employment, and the number of workers in various wage bands. Critical for this analysis, beginning in 2010, the EES began to collect data on vacancies and hiring.

For the main analysis, we focus on 2012 when the most recent census was administered, two years after the first national minimum wage law was implemented when any transitional effects of the minimum wage are likely to have dissipated. We use the census data to measure the population share in each location as well as the share of workers in self-employment. Additionally, we collect data on self-employment earnings from the 2012 Tanzanian National Panel Survey (NPS). We measure self-employment earnings relative to wage earnings using data on consumption per household equivalent by employment type.

We obtain industry level minimum wages from the Tanzanian gazette, a monthly bulletin that reports new laws. For the main analysis, we consider labor market average minimum wages, which are defined as the employment weighted minimum wage in each labor market:

$$m_{ot} = \sum_i \frac{e_{iot}}{e_{ot}} m_i$$

Where m_i is the minimum wage in industry i, e_{iot} is employment in industry i in labor market o at time t, and e_{ot} is total employment in labor market o at time t.

How Representative is the EES? A concern with using the EES data is that firms may misreport employment or wages if they believe that the data could be used by the government to enforce the minimum wage law. We first check how representative employment is by comparing the district employment rates in the 2012 survey with those from the census that was conducted in the same year. In Appendix Figure A.1, we plot the log employment in each district from the two datasets. The values are highly correlated: the slope of the best fit line is 0.97. Total employment in the census is slightly higher than that in the EES. This likely reflects the fact that the EES is unable accurately identify and survey informal firms, so misses some employment. Surveying done in 2024 estimates that 16%

of all businesses are unregistered (National Bureau of Statistics & Office of the Chief Government Statistician, 2024). To adjust for under sampling of firms, we rescale the total number of vacancies by the ratio of census employment to EES employment.

A more likely concern is that firms are mis-reporting their wages. It is not clear in which direction firms are likely to mis-report. Firms may over report if they are paying wages below the minimum wage, but they may under report to avoid additional tax penalties. To be clear, the survey was conducted by the Tanzanian National Bureau of Statistics for the purpose of data collection, and the first page of the survey clearly states that the information is confidential and will not be divulged to any other person or organization. For 2014, we can compare the distribution of wages in the EES with those that were collected in the Living Standards Measurement Study (LSMS) and the Integrated Labor Force Survey (ILFS). In Appendix Figure A.2, we plot the distribution of wages in each of these datasets. The reported wages in the EES lie to the right of those in the two other datasets, suggesting that firms are over-reporting wages. It may be more difficult for firms to mis-report the number of workers in each wage band however. This provides an alternative method to measure the wage distribution. We assume that wages are distributed log-normal, and in Section 5, we estimate the mean and variance of the wage distribution for each industry-location pair.

Minimum Wage Law The Labour Institutions Order of 2010 created Tanzania's first minimum wage laws. The law set forth specific minimum wages for 20 industries and a national minimum wage for all others.[4] The minimum wage floor was set at 80,000 Tanzanian Shillings (TSH), with the industry levels varying between 80,000-3,500,000 TSH, with the exception of agriculture and domestic servants for which it was set below the national floor. With some industry levels being set at the national floor, in practice there were 16 unique levels. We assign to each 2-digit ISIC code a minimum wage level.[5]

[4]See Appendix Tables A.3 and A.4 for descriptive statistics of each industry and its minimum wage level.

[5]For mining there are three different minimum wage levels which correspond to the type of license that the mining company has. In the data, We assume that all mining operations are subject to the lowest minimum wage level. Links to the source documents held by the International Labor Organization online can be found here for 2010 and here for 2013.

3 Motivating Evidence

In this section, we provide motivating evidence that first, there was compliance with the minimum wage law, second, the minimum wage had an effect on vacancy posting and hiring, and third the probability of finding a job is an important determinant in migration decisions.

3.1 Minimum Wage Compliance

The aim of this section is to estimate the rate of compliance with the minimum wage laws. There are two ways to measure the rate of non-compliance with the minimum wage law: the share of workers paid below the minimum wage, and the wage bill share paid below the minimum wage. The former captures the extensive margin of non-compliance, while the latter captures the intensive margin. Using firm-level data from the EES, we define the rate of Employment Non-Compliance (ENC) for firm f in industry i in labor market o in year t to the minimum wage law as

$$ENC_{fiot} = \frac{\sum_{r \in f} n_{rfiot} \mathbf{1}\left[m_i(f) - w_{rfiot} > 0\right]}{\sum_{r \in f} n_{rfiot}}$$

Where r indexes the wage range and n_{rfiot} is the number of workers with wages in that range. $m_i(f)$ is the applicable industry minimum wage and w_{rfiot} is the applicable wage for that range. The ENC multiplied by 100 is the percent of employees in the firm who are paid below the minimum wage. In 2007, 18.9% of employees were paid wages below the proposed minimum wage. In 2010, when the law was enacted, 10.1% of employees were still paid below the minimum wage, representing a 47% rate of compliance with the new law among all employees, consistent with the findings of Bhorat *et al.* (2017) for sub-Saharan African countries.[6]

Since the reported wage-range bands do not line-up exactly with the minimum wage, we construct four measures of the ENC. The preferred estimate assumes a uniform distribution of wages across each range to calculate the share of employees paid below the minimum wage.[7] The lower-bound

[6] Tanzania is an outlier with only 20% compliance in their study. However, they use data from the 2006 ILFS which was conducted prior to the minimum wage law being enacted.

[7] For example, if the firm were to report 10 employees in the wage band 70,000-90,000 and the applicable minimum wage is 80,000, we would count 5 employees as being paid below the minimum wage.

estimate counts only employees in ranges explicitly below the minimum wage and the upper-bound estimate includes all employees in a range that overlaps with the minimum wage. If firms are bunching at the minimum wage, then the upper-bound estimate will mis-report compliance as non-compliance. Additionally, we create a fourth measure, that is not prone to these issues, which includes only firms in industries for which the applicable minimum wage always corresponds to the edge of a wage range.

We estimate the rate of non-compliance for each measure as an event study, limiting our attention to the period 2005-2013 to avoid changes caused by the minimum wage reform in 2014.

$$ENC_{fiot} = \beta_0 + \sum_{t \neq 2007} \delta_t + \boldsymbol{\mu}_i + \boldsymbol{\lambda}_o + \varepsilon_{fiot} \tag{1}$$

Where $\boldsymbol{\mu}_i$ are industry fixed effects and $\boldsymbol{\lambda}_o$ are district fixed effects. The δ_t coefficients capture the share of employees in each year that are paid below the minimum wage relative to the pre-policy year. We plot the coefficients for each estimate in Appendix Figure A.3. For the preferred estimate, the rate of non-compliance falls by 14% in 2010 and continues to trend down. The results for the lower-bound are similar. There is no observed decline in non-compliance for the upper-bound measure which likely reflects bunching at the minimum wage being misclassified as non-compliance. The yellow squares show the trend for firms in industries for which the wage-ranges exactly corresponded to the applicable minimum wage. The trend is similar to that of the preferred estimate, but is less precise, reflecting the smaller sample size.

An alternative approach that has been used in the literature is to define the proportional increase in a firm's wage bill that would be needed to bring all workers up to the minimum wage (Card & Krueger, 1994; Draca *et al.*, 2011; Dustmann *et al.*, 2022). The GAP measure is defined as

$$GAP_{fiot} = \frac{\sum_{r \in f} n_{rfiot} \min\{0, m_i(f) - \bar{w}_{rfiot}\}}{\sum_{r \in f} n_{rfiot} \bar{w}_{rfiot}}$$

Where $\bar{w}_{rfiot}$ is the average wage of workers in wage range r assuming a uniform distribution of wages in each range. The GAP is a measure of the bite of the minimum wage. Multiplied by 100, it is the percent by which the firm would need to raise its wages to be fully compliant with the minimum

wage law.

While event studies show that the law did effect the wages of workers who were subject to the law, they are not informative about the absolute levels of compliance. To assess the absolute level of non-compliance, in Figure 1, we plot the ENC and GAP in levels. In 2010, the ENC was 10.1%, as noted above, and fell to 4.3% by 2013. Similarly, the GAP levels were 7.1 and 5.5% in 2010 and 2013, respectively. Together, this indicates that there were high levels of compliance with the minimum wage law.

3.2 The Effect of Minimum Wages on Hiring

To assess the effect of the minimum wage on hiring and vacancy posting patterns, in Figure 2, we plot the total number of current vacancies and hires in the past twelve months per employee. We classify industries with a minimum wage above 150,000 TSH as high minimum wage industries.

The 2010 minimum wage was implemented in the month prior to the survey, so it should have little effect on hires in the previous year. This is reflected in the figure–there is no difference in the hiring rate between high and low minimum wage industries in 2009. In 2010, the hire rate in high minimum wage industries fell relative to low minimum wage industries, before beginning to rise in 2012. The return towards parity likely reflects inflation that occurred during the period that made the minimum wage less binding.

Data on hiring and vacancies was not collected prior to 2010, so we cannot compare the trend in vacancies prior to the minimum wage implementation. In 2010, low minimum wage industries had more than twice as many posted vacancies as high minimum wage industries. This may reflect a faster job-filling rate in high minimum wage industries if their wages are higher.

If these trends reflect a change in the behavior of workers by searching more in high minimum wage industries, then we should see a shift in total employment into higher wage jobs. In Appendix Figure A.4, we plot the share of workers earning below 150 thousand TSH, 150-300 thousand TSH, and above 300 thousand TSH. The share of workers earning less than 150K prior to 2010 is close to 75%, and falls to just over 50% in 2010. At the same time, the share of workers earning more than

300 thousand TSH rises from around 10% to 25%. Without data for 2008 and 2009, we cannot rule out that wages are following a trend, however, there is no apparent trend between 2005-2007.

3.3 Minimum Wages and Migration

Standard models of spatial equilibrium explain migration flows between locations through variation in wages and amenities. But there is not just one wage in a location nor will all migrants become employed. To investigate the relative importance of wages and employment on migration patterns, we estimate

$$\log \text{immig}_o = \log w_o + \log e_o + \varepsilon_o \tag{2}$$

Where immig_o is immigration into district o in the 2012 census, w_o is the average wage in o, and e_o is total wage employment as reported in the census.

We report the estimation results of (2) in Table 2. Column 1 reports the direct effect of wages on immigration without controlling for employment. The coefficient is insignificant and actually slightly negative. In column 2, we control for employment, and the estimated wage elasticity rises to 0.52 ($p < 0.05$). However, the estimated employment elasticity is 0.41 ($p < 0.01$), indicating that the likelihood of finding a job is an important determinant in migration decisions. To control for the endogeneity of wages, in column 5, we instrument for wages using log vacancies and the log average minimum wage. The estimated wage elasticity rises to 2.53 ($p < 0.05$), significantly higher than the employment elasticity of 0.50 ($p < 0.01$), indicating that indeed wages are the most important driver of migration, but that the probability of finding a job is also important.

The F-stat is 7.5, suggesting that the instruments are somewhat weak. In column 6, we report the first-stage results. Wages are positively correlated with the minimum wage, consistent with the findings in the previous section that there is some compliance with the minimum wage law. Wages are also highly correlated with vacancies, suggesting that labor markets that are growing are posting higher wages to attract more workers. In column 3, we report the direct effect of the minimum wage on immigration. The estimated elasticity is 1.2, though statistically insignificant. In column 4, we report the estimated vacancy elasticity of immigration, which is 0.17 ($p < 0.01$), indicating that

additional job opportunities are an important determinant of immigration patterns.

4 Economic Framework

In this section, we develop a continuous time model of search and matching with multiple labor markets and migration. The economy is composed of a finite number of labor markets which are indexed by o. We use the generic index d when referring to the set of all locations. Each location is endowed with a measure of workers ($\bar{L}_o$), where $\sum \bar{L}_o = 1$, and a distribution of potential job productivities $y_o \sim$ log Normal$(\bar{y}_o, \sigma_o^2)$. Both workers and firms discount the future at rate $1 - r < 1$ where r is the interest rate.

There is no unemployment in the economy *per se*. Workers are either self-employed (s) or employed in a firm (e). There is no on-the-job search, meaning that only self-employed workers can migrate. At any point in time, in each location there are $s_o L_o$ self-employed and v_o vacancies, where L_o is the period measure of workers in o. Workers are matched with jobs via the constant returns to scale matching function: $R_o(sL, v) = Z_o(sL)^{\alpha} v^{1-\alpha}$. The constant Z_o captures the location specific matching productivity. Define the vacancies per self-employed workers $\theta = v/(sL)$. Then the vacancy filling rate is $q_o(\theta) = R_o/(vL) = A_o\theta^{-\alpha}$. Self-employed workers receive job offers at the rate $\theta q_o(\theta)$ which exceed their reservation wage ($\bar{w}_o$) with probability p_o, and jobs are destroyed exogenously at the rate δ_o. In equilibrium, the job destruction rate equals the job creation rate, implying that the self-employment rate in o is:

$$s_o = \frac{\delta_o}{\delta_o + p_o \theta_o q(\theta_o)} \tag{3}$$

Vacancies To post a vacancy in o, the firm must pay the vacancy posting cost, κ_o. With probability $q(\theta_o)$ a worker is matched with the vacancy. When a match occurs, a job productivity $y \sim F_o(y)$ is realized. When y exceeds the reservation wage, the firm and worker bargain on a wage, otherwise the match is destroyed. Let $E[J]$ be the expected value of a filled job, then the present value of posting a vacancy (V) is:

$$rV = -\kappa_o + q_o(\theta_o)(p_o E[J] - V)$$

Let $w(y)$ be the negotiated wage of the job, then the expected value of a job to a firm is:

$$E[J] = \frac{E[y - w(y)|w(y) \geq \bar{w}_o]}{r + \delta_o} \tag{4}$$

Under the assumption that the value of an unfilled vacancy is zero, the unconditional expected value of posting a job is equated with the per period cost of posting a job times the expected time to fill the position, or $p_o E[J] = \kappa_o / q_o(\theta_o)$. In equilibrium, vacancy creation is determined by:

$$E[y - w(y)|w(y) \geq \bar{w}_o] - \frac{\kappa_o(r + \delta_o)}{q(\theta_o)p_o} = 0 \tag{5}$$

Equation (5) says that firms will post vacancies until the expected value of a filled job equals the expected total cost of posting a vacancy. The total number of vacancies is increasing in the number of workers searching, and decreasing in vacancy posting costs (κ_o), job separation rates (δ_o), and reservation wages ($\bar{w}_o$).

Workers Migration is costly, however the cost varies across workers, locations, and over time. At each moment in time, a worker's idiosyncratic migration costs are characterized by a vector of independent shocks $\zeta = \{\zeta_d\}$ which are drawn from a Fréchet distribution with scale parameter ϕ. The total cost of migrating is $\zeta_d \tau_{od} / \zeta_o$, where τ_{od} is the fixed cost of migrating from o to d and ζ_o is the aggregate mobility cost. In practice, τ_{od} captures the time-invariant costs of migration such as linguistic differences and distance, while ζ_d captures individual migration networks that may change over time, and ζ_o captures the time-varying costs of choosing to migrate, such as familial constraints or health.

The timing for workers is as follows: at each 'moment' in time, employed workers become unemployed with probability δ_o, and self-employed workers are matched with a job with probability $\theta_o q_o(\theta_o)$, which they accept with probability p_o. Then workers' vector of idiosyncratic migration costs, $\{\zeta\}$, are updated, and they choose to stay and earn the self-employment income w_{so} or to migrate. It is assumed that workers who choose to migrate are initially self-employed at their destination. The value for the self-employed worker at the moment when making the migration decision (V_o^m) can be

characterized by:

$$V_o^m = \max\left\{V_o^s,\ \zeta_o^{-1}\max_{d\neq o}\left\{\tau_{od}\zeta_d V_d^s\right\}\right\}$$

Where V_o^s is the value of being self-employed in o. Then it is optimal to migrate whenever the value of self-employment in d, (V_d^s), discounted by the utility cost of migrating $\tau_{od}\zeta_d/\zeta_o$ exceeds the value of self-employment at home. The share of self-employed workers who choose to migrate from o to d at any moment in time is:

$$\pi_{od} = \left(\frac{(\tau_{od}V_d^s)^\phi}{\sum_d (\tau_{od}V_d^s)^\phi}\right) \tag{6}$$

Where $\tau_{oo} = 1$ by definition. In Appendix A, we show that in expectation, the value of having the option to migrate can be expressed relative to the value of self-employment as:

$$E[V_o^m] = V_o^s(1+\psi_o) \tag{7}$$

Where ψ_o captures the additional benefit of being self-employed today because of the possibility of migrating tomorrow, where

$$\psi_o = \left(\Gamma\pi_{oo}^{\frac{-1}{\phi}} + (1-\Gamma)\,\pi_{oo}\right) - 1 \tag{8}$$

and the weights Γ are:

$$\Gamma = \frac{\pi/\phi}{\sin(\pi/\phi)}$$

When there is no migration ($\tau_{od} = 0\,\forall d \neq o$), (8) is zero, and the model nests the no migration case, $E[V_o^m] = V_o^s$. Whenever $\pi_{oo} < 1$, ψ_o is strictly positive. Appealing to this definition, the value of self-employment can be characterized as:

$$rV_o^s = w_{so} + V_o^s\psi_o(1 + p_o\theta_o q_o(\theta_o)) + p_o\theta_o q_o(\theta_o)\left(\int_y V_o(w(y))\partial F_o(y) - E[V_o^m]\right) \tag{9}$$

Without migration ($\psi_o = 0$), (9) reduces to the standard single labor-market expression: the present value of being self-employed is equal to the self-employment income plus the probability of being matched with a job times the expected value of employment less the value of self-employment. With

migration, the present value of self-employment is strictly higher. This gain is derived from two channels. First, a worker who is self-employed today, may get a good draw of the migration costs tomorrow and choose to migrate to another labor market. Second, a worker who is matched with a job has more bargaining power because they have the option to migrate which means that the wage will be a higher share of the job productivity. The value of a job paying wage w, $(V_o(w))$ in (9) is:

$$V_o(w) = \frac{w + \delta_o E[V_o^m]}{r + \delta_o} \tag{10}$$

Wage Determination Wages are determined via Nash bargaining, with weights given by η. The value of a job paying w to the firm is the realized value of (4), and the value of accepting a job to a worker is given by $V_o(w) - E[V_o^m]$. Subtracting $E[V_o^m]$ from (10), wages are then determined by:

$$w = \arg\max \left(\frac{w - rE[V_o^m]}{r + \delta_o} \right)^{\eta} \left(\frac{y - w}{r + \delta_o} \right)^{1-\eta}$$

In equilibrium the wage is then a weighted average of the job productivity, y, and the discounted value of the migration decision, $rE[V_o^m]$, which can be expressed in terms of the value of self-employment as:

$$w^*(y) = (1 - \eta)(1 + \psi_o) r V_o^s + \eta y \tag{11}$$

A match is accepted whenever the wage exceeds the reservation wage, which is $\bar{w}_o = (1 + \psi_o) r V_o^s$, implying that the probability that a job is accepted is $p_o = 1 - F_o((1 + \psi_o) r V_o^s)$. Appealing to these definitions, we can express the present value of self-employment in o in terms of the job productivity distribution as:

$$r V_o^s = \Upsilon(\theta_o, \psi_o) \left(A(\theta_o, \psi_o) w_{so} + (1 - A(\theta_o, \psi_o)) \frac{E\left[y | y \geq \bar{w}_o\right]}{(1 + \psi_o)} \right) \tag{12}$$

Where

$$A(\theta_o, \psi_o) = \left(\frac{(r + \delta_o)}{r + \delta_o + \eta p_o \theta_o q_o(\theta_o)(1 + \psi_o)} \right)$$
$$\Upsilon(\theta_o, \psi_o) = \frac{r}{r - A(\theta_o, \psi_o)\psi_o(1 + p_o \theta_o q_o(\theta_o))}$$

Steady State Equilibrium A steady-state equilibrium in this economy is a set $\{w_o(y), \theta_o, v_o, s_o, L_o\}$ for each o such that:

1. The number of vacancies in each labor market, v_o, is consistent with (5)
2. Wages are determined by (11)
3. Job creation equals job destruction, and self-employment in each location is determined by the Beveridge curve (3)
4. Net migration flows lead to fixed population shares:

$$L_o s_o (1 - \pi_{oo}) = \sum_{d \neq o} \pi_{do} L_d s_d$$

5. The value of self-employment is consistent with the productivity distribution (12)

Surplus from a match The total surplus of a job match (S) is:

$$S = \frac{y - (1 + \psi_o) r V_o^s}{r + \delta_o}$$

Relative to the standard model, the surplus from a job match is lower because workers who do not receive a match have the possibility of migrating to a different location tomorrow, and finding a better outcome.

4.1 Equilibrium with a Minimum Wage

In this section, we show how a minimum wage, which may vary across space, affects the spatial distribution of labor and jobs through its effects on the value of self-employment and vacancy creation.[8] Let m_o be the minimum wage in o. To be consistent with the empirical observation that compliance with the minimum wage is not perfect, we make the assumption that the government perfectly enforces the minimum wage in all jobs such that $y \geq m_o$, and chooses to not enforce the minimum wage whenever $y < m_o$ to maintain employment.[9] Then for each minimum wage there exists a productivity threshold $\hat{y}_o$ such that $m_o = \eta\hat{y}_o + (1-\eta)(1+\psi_o)rV_o^s$. In other words, $\hat{y}_o$ is the productivity draw such that the unconstrained equilibrium wage would be exactly equal to the minimum wage, $m_o = w(\hat{y}_o)$. Then for jobs with $y \in [m_o, \hat{y}_o]$, the minimum wage binds, and for those with $y > \hat{y}_o$ and $y < m_o$, it does not. The value of self-employment with a minimum wage is:

$$rV_o^s = \Upsilon(\theta_o, \psi_o)\left(A(\theta_o, \psi_o)w_{so} + (1 - A(\theta_o, \psi_o))\frac{(E\left[y|y \geq \bar{w}_o\right] + \hat{y}_o - E[y|m_o < y \leq \hat{y}_o])}{(1+\psi_o)}\right) \tag{13}$$

To see how the minimum wage affects the value of self-employment, we can compare the value function in equation (13) with that in equation (12). The minimum wage increases the value of self-employment both directly and indirectly. The direct effect is through the increase in the expected job productivity value from the perspective of the worker. Whenever the minimum wage exceeds the reservation wage, $\hat{y}_o - E[y|m_o < y \leq \hat{y}_o] > 0$. The extent to which this value rises will depend upon the share of jobs that are constrained by the minimum wage. The indirect effect of the minimum wage occurs through two channels. Locally, it increases the wage for all workers by raising their bargaining power whenever the realized job productivity $y \notin [m_o, \hat{y}_o]$. This affects equation (13) through the reservation wage, which rises, meaning that workers accept fewer jobs. Spatially, the minimum wage raises the value of being in all other labor markets, which causes ψ_o to rise. Whenever the bite of the minimum wage, $\hat{y}_o - E[y|m_o < y \leq \hat{y}_o]$, varies across labor markets the relative value of labor

[8] In Appendix A, we consider an industry-specific minimum wage. This allows the minimum wage to endogenously vary across labor markets due to variation in the distribution of industry productivities across space.

[9] The enforcement decision and the decision to comply are discussed in Marshall (2025a)

markets will change. This does not necessarily mean that workers will move to the labor market where the bite is highest because the minimum wage also affects vacancy posting.

For firms, the value of a filled job becomes:

$$J_o(y, m_o) = \begin{cases} \frac{y-w(y)}{r+\delta_o} & \text{if } y < m_o \\ \frac{y-m_o}{r+\delta_o} & \text{if} \quad y \in [m_o, \hat{y}_o] \\ \frac{y-w(y)}{r+\delta_o} & \text{if} \quad y > \hat{y}_o \end{cases} \tag{14}$$

Whenever the minimum wage exceeds the reservation wage, equation (14) states that in expectation, the value of a job to a firm falls. This affects vacancies by reducing the expected profit of a posting a vacancy:

$$(1-\eta)\left(E\left[y|\bar{w}_o \leq y\right] - \bar{w}_o\right) + \eta\left(E\left[y|\bar{w}_o \leq y < \hat{y}_o\right] - \hat{y}_o\right) - \frac{\kappa_o(r+\delta_o)}{q(\theta_o)p_o} = 0 \tag{15}$$

Relative to the unconstrained case, the value of posting a vacancy falls by $\eta\left(E\left[y|\bar{w}_o \leq y < \hat{y}_o\right] - \hat{y}_o\right)$. Without migration, this implies that the number of vacancies will be strictly lower. With migration, the change will depend upon the population response. When workers emigrate from o, there will be fewer workers searching, and the expected time to fill a vacancy will rise, meaning that firms will post even fewer vacancies. However, when workers immigrate to o, more workers will be searching and the expected time to fill a job will fall. This will cause vacancy posting to increase whenever the rise in labor market tightness causes the expected cost of posting a vacancy to fall by more than the expected profit.

Together, equations (13) and (15) imply that the effect of the minimum wage on migration is ambiguous. Equation (13) suggests that workers will migrate to labor markets where the bite of the minimum wage is the largest. However, equation (15) states that these labor markets are precisely those in which vacancies, and hence employment will fall the most.

5 Calibration and Estimation

The aim of this section is to calibrate the elasticities that govern the model $\{\alpha, \eta, \phi\}$ as well as the parameters that determine the equilibrium in each location $\{Z_o, \kappa_o, \delta_o, \bar{y}_o, \sigma_o^2, w_{so}, L_o, \tau_{od}\}$. The unit of analysis is the region, for which there are 23. We estimate the population shares, L_o, using the 2012 population data from the Census.

Estimation of the Matching Function The matching function in each location is defined as $q_o(\theta) = Z_o\theta^{-\alpha}$. Total hires in labor market o are then defined as $h_o = s_o L_o Z_o \theta_o^{1-\alpha}$. We estimate the matching elasticity α, using data on hires and vacancies from the EES between 2010 and 2014 with the implied self-employment rate from the Census as:

$$\log\left(\frac{h_{ot}}{s_{ot}L_{ot}}\right) = \beta_0 + \beta_1 \log\theta_{ot} + \varepsilon_{ot} \tag{16}$$

We report the estimation results of (16) in Table 3. α can be interpreted as $1 - \beta_1$. In column 1, we report the two-way fixed-effects results. These results may be biased due to measurement error in the estimated self-employment rate in each location, which is imputed from growth rates between the 2002 and 2012 censuses. To assess the extent of this bias, in column 2, we report the cross-sectional results for 2012 only. The estimate of α falls slightly from 0.4 to 0.3. In columns 3 and 4, we re-estimate (16) without controlling for the population share, L_o. As this affects both the estimated hiring and vacancy measure, the results are quite similar. For the baseline estimation, we calibrate $\alpha = 0.35$. The matching TFP is then extrapolated to fit the 2012 data as:

$$Z_o = \exp\left(\log\left(\frac{h_o}{s_o L_o}\right) - (1-\alpha)\log\left(\theta_o\right)\right)$$

In Table 4, we report the mean, minimum and maximum of the estimated parameters. The matching TFP, Z_o, is on average 0.03, an order of magnitude less than estimates for the US (Shimer, 2005), consistent with high search frictions in developing labor markets (Abebe *et al.*, 2020).

Productivity Distribution To estimate the productivity distribution in each location, we first estimate the wage distribution using EES data on firm employment in each wage bin. Under the assumption that wages in each industry are distributed log-Normal with mean $\bar{w}_{oi}$ and variance σ_{oi}, we can estimate those parameters of the wage distribution using the observed shares in each wage band as:

$$\sigma_{oi} = \sum_k \left(\frac{empl_{oi,k}}{empl_{oi}} \right) \frac{\log(w_{ub,k}) - \log(w_{lb,k})}{\Phi^{-1}(P_{oi}(w \leq \log(w_{ub,k}))) - \Phi^{-1}(P_{oi}(w \leq \log(w_{lb,k})))}$$

$$\bar{w}_{oi} = \sum_k \left(\frac{empl_{oi,k}}{empl_{oi}} \right) \left(\log(w_{ub,k}) - \sigma_{oi} \Phi^{-1}(P_{oi}(w \leq \log(w_{ub,k}))) \right)$$

Where $w_{ub,k}$ and $w_{lb,k}$ are the upper and lower bounds of wage range k, respectively, $P_{oi}(w \leq \log(w_{ub,k}))$ is the share of workers in industry i in labor market o earning less than $w_{ub,k}$, and $\Phi^{-1}(\cdot)$ is the Z-value from the standard Normal distribution with mean zero and variance one evaluated at P_{oi}. $\bar{w}_o$ and σ_o are then calculated as the employment weighted averages of $\bar{w}_{oi}$ and σ_{oi}, respectively. Finally, we calculate the mean of the productivity distribution using the estimated wage markdowns in each labor market from Marshall (2025b), $\bar{y}_o = \bar{w}_o - \log(\mu_o)$. We estimate the self-employment income in each location w_{so} using the ratio of average consumption per capita between wage workers and the self-employed in the 2012 LSMS, which we translate into wage units using the mean of the wage distribution.

The estimated values for y_o and σ_o in Table 4 imply an average wage of 469 and a median wage of 380, significantly higher than the unclassified-industry minimum wage of 80. This difference is consistent with the finding in Section 3 that in 2012, just 5% of workers were earning wages below the minimum wage. The share of jobs that are constrained by the minimum wage, reported at the bottom of the table, is on average 1.7 percent. It is important to note that this number does not include jobs in which workers are paid below the minimum wage.

Initial Equilibrium The remaining parameters that we need to estimate are $\{\kappa_o, \delta_o, \tau_{od}\}$. Because we observe the non-migration shares in the data, π_{oo}, if we have a value for the migration elasticity, ϕ, then we can directly calculate ψ_o without any information about other labor markets. This means that

we can solve for the economy-wide equilibrium recursively. In other words, we only need to solve for the local labor market equilibrium to estimate κ_o and δ_o. Once we have done that, we can calculate the $\{\tau_{od}\}$ as the migration costs that yield a fixed point for the population shares.

To solve the local labor market equilibrium, we iterate on the self-employment value function, rV_o^s until we find a fixed point. To do so, we begin with an initial guess of the present value of self-employment equal to rw_{so}. From this we can calculate the probability that a worker will accept a job, $p_o = 1 - F_o((1+\psi_o)rV_o^s)$, which allows us to estimate a new value for rV_o^s, and we iterate on the value function until we find a fixed point.

Our estimates of ψ_o in Table 4 mean that having the option to migrate increases worker's bargaining power by, on average, 1.7 percent, and as much as 3.7 percent in some locations. This variability reflects both variation in the ease of emigrating as well as the relative value of the worker's own labor market relative to all other labor markets. The separation rate, δ_o ranges from 0.02 to 0.38, which may reflect higher turnover in rural areas where workers are constrained by own farm agriculture during the planting and harvesting season. The average cost of posting a vacancy, κ_o, is 84.3, which is slightly higher than the typical minimum wage faced by a firm, indicating that firms also face substantial hiring costs.

We estimate the migration costs as the set $\{\tau_{od}\}$ that yield a fixed point for the population shares. The set of $\{\tau_{od}\}$ that yield a fixed point are not unique. For example, a no migration equilibrium in which $\tau_{od} = 0 \,\forall\, o \neq d$ would yield a fixed point for the population shares. On the other hand, one could begin with no migration costs, $\tau_{od} = 1 \,\forall\, o, d$, and find a fixed point in which there are large migration flows between locations, but no net changes in any single labor market. We take an alternative approach to discipline our estimates of the $\{\tau_{od}\}$, by beginning with the migration shares that we observe in the data, π_{od}^{data}, which we use to estimate a new population in each location as:

$$L_o^{model} = L_o^{data}(1 - s_o) + \sum_d L_d s_d \pi_{do}^{data} \tag{17}$$

Equation (17) says that the new estimate of the population in o is equal to the employed workers there who, by assumption, cannot migrate plus the share of self-employed workers from all labor markets,

including o, who choose to migrate (or stay) in o. We then update the migration shares as:

$$\pi_{od}^{update} = \pi_{od}^{\frac{L_o^{model}}{L_o^{data}} \frac{L_d^{data}}{L_d^{model}}}$$

In words, whenever we overestimate the population in o, we reduce the cost of migrating to all other labor markets, d, and whenever we overestimate the population in d we increase the cost of migrating to d from all other labor markets, o. We then iterate on (17) using the new estimate of migration shares until we find a set of $\{\hat{\pi}_{od}\}$ that yields $L_o^{model} = L_o^{data}$ for all o. Appealing to equation (6), we can then calculate the τs in the model directly as:

$$\tau_{od} = \frac{rV_o^s}{rV_d^s} \left(\frac{\hat{\pi}_{od}}{\hat{\pi}_{oo}} \right)^{\frac{1}{\phi}} \tag{18}$$

6 Policy Analysis

In this section, we begin by quantifying the role of minimum wages on the spatial distribution of economic activity. We then consider alternative policies and how they compare in terms of both local and aggregate surplus.

In the data, we only observe the equilibrium with the minimum wage. This means that to quantify the effect of Tanzania's minimum wage, we must compare the observed policy equilibrium with the counterfactual no-policy equilibrium. In Figure 3, we plot the change in vacancies by labor market when moving from the unconstrained (no minimum wage) equilibrium to the equilibrium with a minimum wage. In panel A, we compare the predicted changes with and without migration. Consistent with the predictions of equation (15), when there is no migration, depicted by the triangles, the minimum wage reduces the expected value of posting a vacancy and vacancies fall. However, when there is migration, depicted by the circles, vacancy posting may rise. In some locations, vacancies fall by even more when there is migration, consistent with emigration leading to longer expected times to fill a job. To see how population change is related to vacancy posting, in panel b, we plot the change in vacancies by the change in population. While an increase it population is a necessary condition

for vacancies to rise, it is not a sufficient condition, and some locations that experienced a rise in population still saw a fall in total vacancies.

To see how migration responds to changes in wages and employment, in Figure 4, we plot these relationships. Panel A, plots the change in population against the change in wages. In most locations, average wages rise. However, in the locations in which population rises the most, wages fall slightly. This is because the reservation wage depends upon the option value of migrating. When a worker is located in a high value location, there is less benefit to migrating, so the reservation wage falls relative to the no minimum wage equilibrium. The figure depicts a strong negative relationship between changes in population and wages, which is the opposite of the relationship between population and employment in Panel B. While employment falls in most labor markets, it rises in those where population grew the most–precisely those locations in which the reservation wage, and hence average wages fell. Together, these figures indicate that it is employment, not wages that is driving migration.

The relationships in Figure 4 are almost mirror images of one another, which reflects the linear utility function in income. If we imposed concavity on the utility function, then employment would become even more important than wages, meaning that these estimates of the importance of employment for migration are likely lower bounds on the true importance.

Local versus National Minimum Wages The ILO recommendation is to set local area minimum wages relative to the cost of living. Measuring the cost of living in rural areas may be challenging if many residents are consuming their own-farm production. Instead, Tanzania chose to set the minimum wage by industry, which created spatial variation in the average minimum wage faced by a firm through variation in industrial composition. We now ask, what would we have observed if Tanzania had implemented either a local or national minimum wage. To do so, we compare two policies. The local minimum wage policy sets the minimum wage in each location at the fifth percentile of of the job productivity distribution, and the national minimum wage fixes a single minimum wage at the fifth percentile of aggregate productivity. We plot the simulated changes in population and vacancies under these two policies in Figure 5. While the national minimum wage will constrain more productivity draws in low productivity locations, variation in the bite of the local minimum wage

across labor markets will be determined by job posting costs, reservation wages, and the variance of the productivity distribution.

To understand the outcomes in Figure 5, first consider how the two policies change the relative value of locations from the perspective of a worker, when holding the firm response fixed. Since the national minimum wage constrains more jobs in low-productivity locations, it should induce labor to move out of high-productivity and into low-productivity locations. The local minimum wage will have a similar effect across locations, so changes in population should be unrelated to the productivity of each location. However, in Panel A the relationship is reversed–the national minimum wage induces migration towards high productivity locations while the local minimum wage induces migration towards low productivity locations. This is precisely because of the equilibrium response of firms in posting vacancies depicted in Panel B. From the perspective of firms, those in high-productivity locations are less constrained by the national minimum wage than the local minimum wage. As was shown in Figure 4, immigration is rising in employment, not wages. As a result, the model makes the counterintuitive prediction that a single national minimum wage will increase migration towards more productive labor markets.

Subsidizing Vacancies An alternative policy is to subsidize vacancy creation. To do so, we introduce a government sector which subsidizes the cost of posting a vacancy. We consider a fixed subsidy (φ_o), such that the per-period cost of posting a vacancy is $\kappa_o - \varphi_o$. The subsidy is financed through a proportional tax on wages (τ_o) which is paid for entirely by the worker. In other words, when a match occurs, the firm still receives $y - w$ in each period, while the worker receives $w(1 - \tau_o)$. Under this policy the total number of vacancies in o is given by:

$$v_o = s_o L_o \left(\frac{Z_o p_o (1-\eta) \left(E[y|y \geq \bar{w}_o] - \bar{w}_o \right)}{(\kappa_o - \varphi_o)(r + \delta_o)} \right)^{\frac{1}{\alpha}} \tag{19}$$

The policy has two direct effects on vacancy posting: it raises the number of vacancies by making it less costly to post, and it reduces the expected value of posting a vacancy by raising workers' reservations wages by $(1 - \tau_o)^{-1}$, which reduces the number of vacancies.

From the perspective of the worker, the policy increases the probability that they will be matched with a job and reduces the value of accepting a job because of the tax on wages. When a match occurs, this changes the bargaining position of the worker: the value of accepting is lower because of the tax, while the value of declining is higher because the labor market is tighter. What this means is that the extent to which the tax is passed through to the firm depends upon how much the value of self-employment changes. Let $V_o^s(\tau)$ be the value under tax policy $\tau = \{\tau_1, \ldots, \tau_o, \ldots, \tau_D\}$, then in equilibrium the wage is given by:

$$w^*(y|\tau_o) = (1-\eta)\frac{(1+\psi_o)rV_o^s(\tau)}{(1-\tau_o)} + \eta y \tag{20}$$

This means that if there is no change in the value of self-employment, the tax will be fully passed through to the firm, and as $V_o^s(\tau)$ rises, less of the tax will be passed through. Under the policy, the present value of self-employment is:

$$rV_o^s(\tau) = \Upsilon_o\left(A(\theta_o,\psi_o)w_{so} + (1-A(\theta_o,\psi_o))\frac{(1-\tau_o)E\left[y|y\geq\bar{w}_o\right]}{(1+\psi_o)}\right) \tag{21}$$

While the tax reduces the expected value of a job, $\partial A(\theta_o,\psi_o)/\partial\theta_o < 0$, meaning that more weight is put on the expected value of a job because labor market tightness rises.

Equation (19) implies that the spatial distribution of job creation can be targeted towards more productive locations, while equation (21) states that the extent to which such a policy can be used to redirect migrants depends upon how the subsidy is financed. To highlight this channel we consider both a local and national financing policy. Under the local system, the subsidy is financed entirely by a tax on local wages, whereas under the national system, the subsidy is financed through a national tax on wages. In Appendix A.2, we derive the equilibrium tax for these two systems that balance the government budget.

In Table 7, we report the simulation results of a vacancy subsidy that is calibrated to 10 percent of the local vacancy posting cost. In columns 1-4, we report the equilibrium financed through a local tax on wages. To subsidize vacancies, wages are taxed on average 1.6%, whereas average wages rise by

0.6%, indicating that around one-third of the tax is passed through to the firm. The low tax rate is partly attributed to 13.5% rise in employment. While the surplus per match falls slightly, total surplus rises by 12.9% because of the increase in total employment. In columns 5-8, we contrast these results with those under a policy that is financed through a national tax on wages. This policy results in a slightly lower tax rate of 1.5% despite a smaller gain in employment. This translates into slightly lower reservation wages, which increases vacancies. The smaller gain in employment is not enough to offset the effect of lower reservation wages, and the gain in total surplus is 1.2% less.

Discussion How should we interpret the contrasting findings of the two types of policies? In low-income countries, wage employment is much less than in high-income countries. A natural question to ask is whether this is because of supply forces (wages are too low) or demand forces (hiring is too costly). Contrasting a minimum wage policy with a vacancy subsidy policy makes clear which of these two forces is dominant. Minimum wages shift the surplus of a job match from the firm to a worker, whereas a vacancy subsidy shifts surplus from the worker to the firm. In Table 8 this point is made explicit. Both the local and national minimum wage policies reduce the firm's surplus from a match by over 20% whereas the worker's surplus rises by over 10%. In contrast, because the vacancy subsidy raises workers' outside option value, the surplus from a match falls slightly for both workers and firms. However, the fall in match surplus for the firm is slightly less, and this difference is magnified when we consider total surplus, for which the gains are accrued more heavily by firms. In other words, because minimum wages reduced employment whereas vacancy subsidies increased employment, we can conclude that employment is low because of demand forces.

7 Conclusion

The use of minimum wage laws in developing countries, particularly in Sub-Saharan Africa, is on the rise. As populations become increasingly urbanized, understanding the effects of minimum wage laws is critical. In 2010, Tanzania enacted a complex minimum wage law that dictates specific levels for more than 20 sectors, as well as a national floor. We find evidence of partial compliance that had

heterogeneous effects on hiring and vacancy posting. The law also affected the location decision of workers through its effect on wages and employment.

We develop a spatial equilibrium search and matching model to quantify the effect of Tanzania's minimum wage on the spatial distribution of activity. The law had a heterogeneous effect across space. Locations in which the minimum wage had a large bite experienced significant population gains, which led to more employment and higher wages. However, in many locations, population fell, which reduced the value of posting a vacancy for firms, causing wage employment to fall. Overall, the minimum wage reduced total surplus by substantially increasing the labor share in less productive locations. That is, minimum wages have the counterintuitive effect of causing workers to move into less productive areas, thereby reducing efficiency. However, the shortfall in surplus is lower under national, rather than local, minimum wages. These results suggest that variable minimum wage laws can be used to reallocate labor across space.

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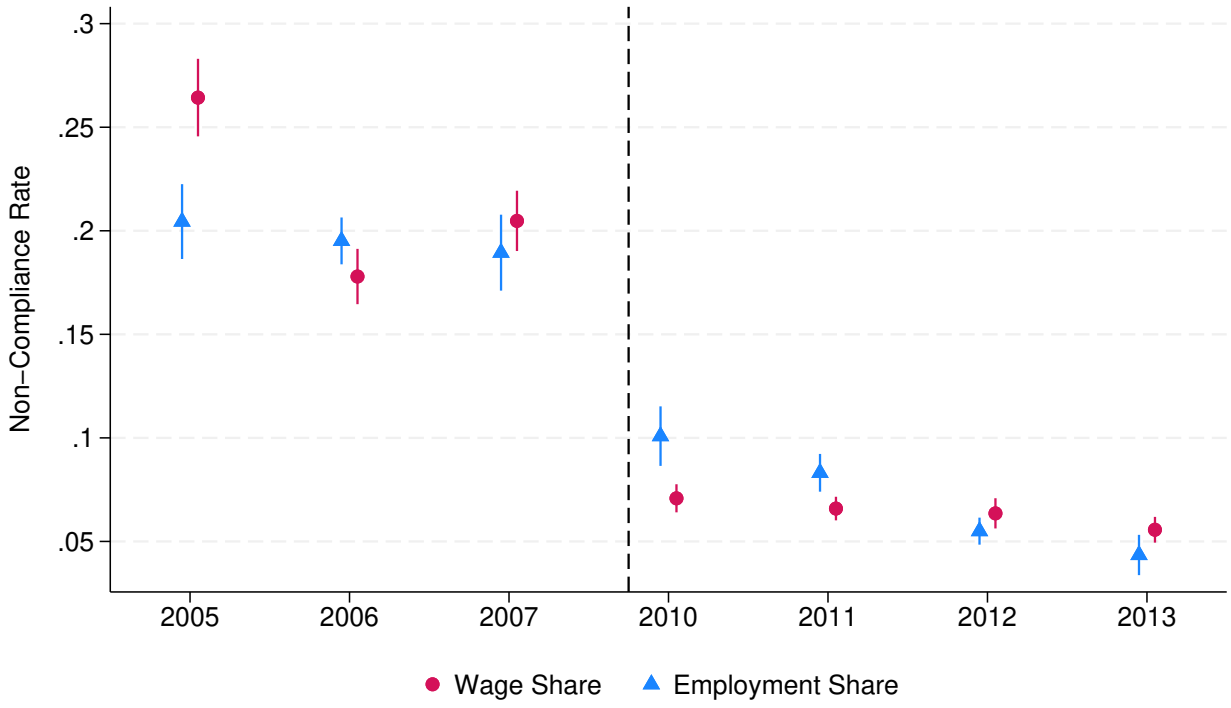
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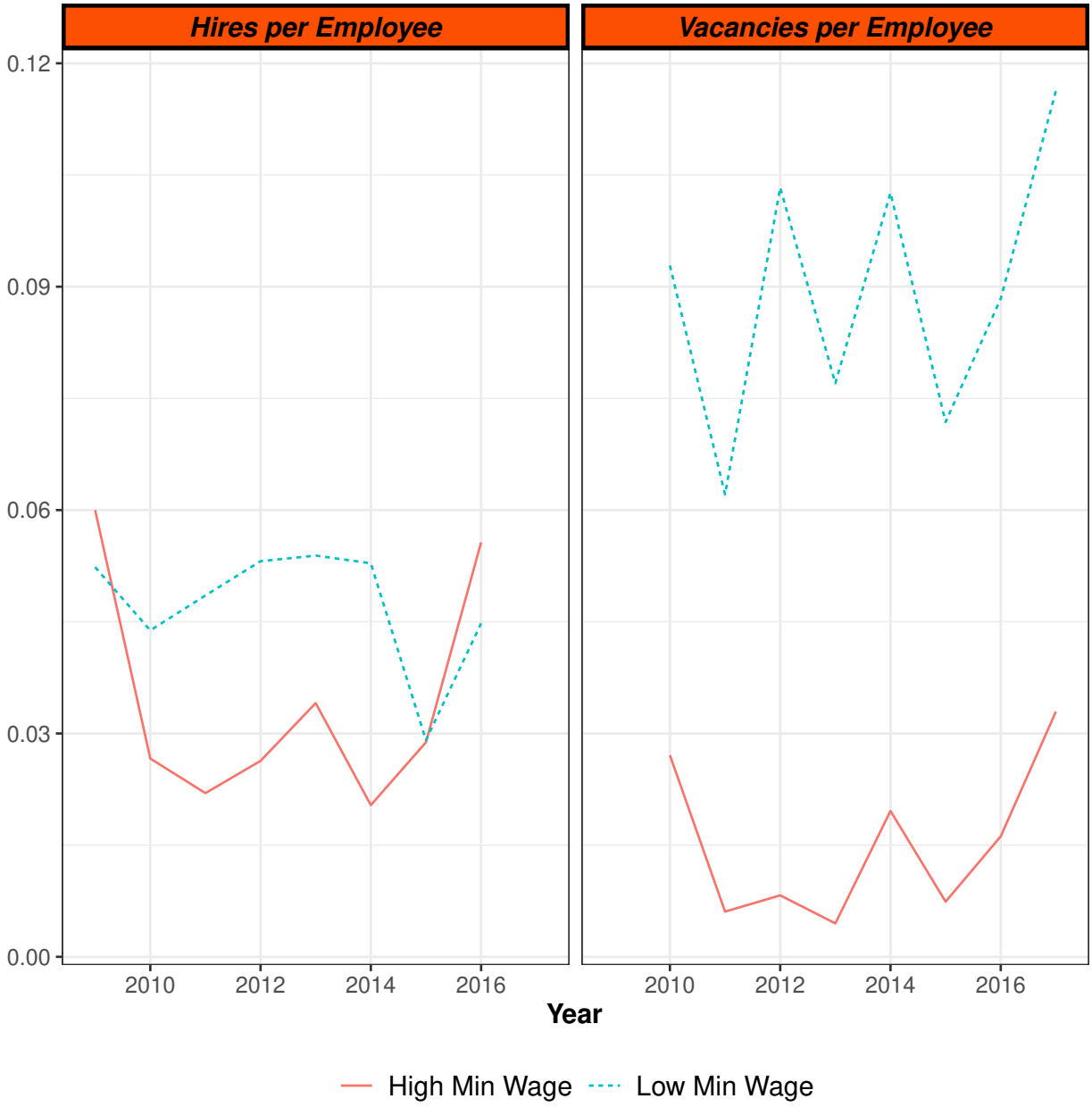
Figures & Tables

Figure 1: Employment and Wage Bill Non-Compliance Rate Levels



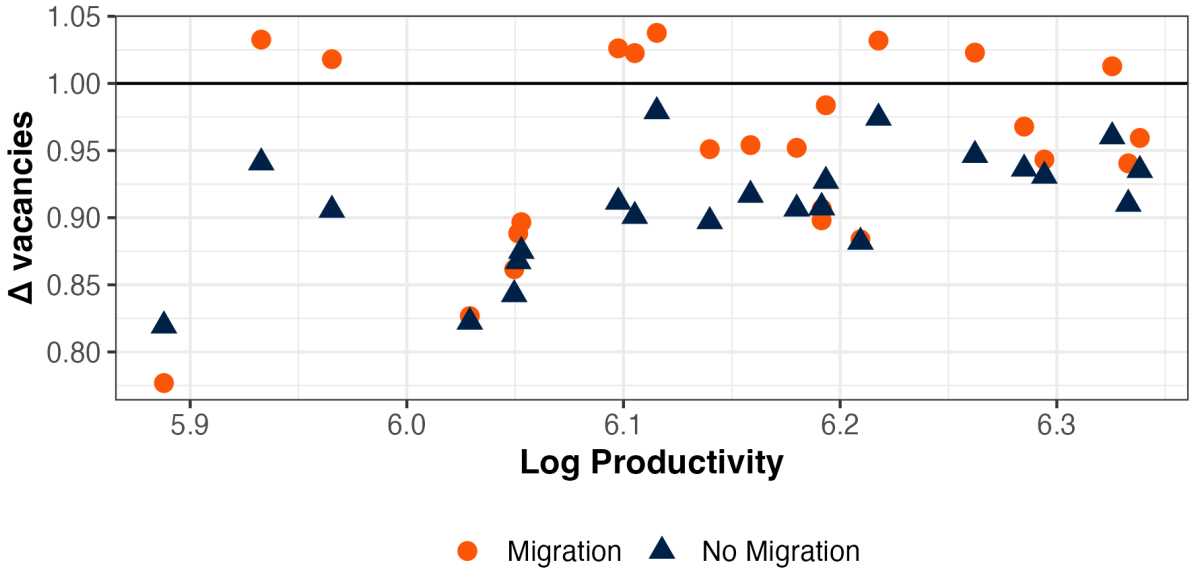
Notes: Reporting the ENC and GAP levels in each year and 95% confidence intervals. $N = 67,010$ firm-year observations. The wage share equation is weighted using survey weights and the employment equation is weighted using survey times employment weights. The dashed line indicates the introduction of the 2010 minimum wage law.

Figure 2: Hires and Vacancies per Employee by Minimum Wage Level

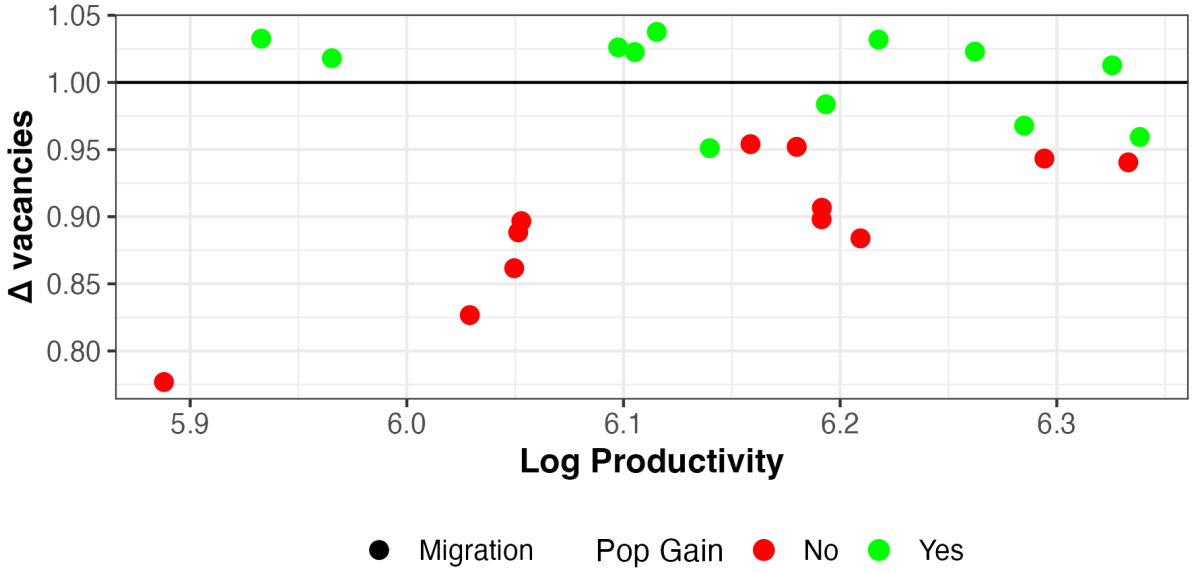


Notes: Displaying the total number of hires in the current year over total employment and the total number of vacancies during June of the current year over total employment. Sectors with a minimum wage above 150,000 TSH in 2010 are defined as high minimum wage sectors.

Figure 3: Counterfactual Changes in Vacancy Creation



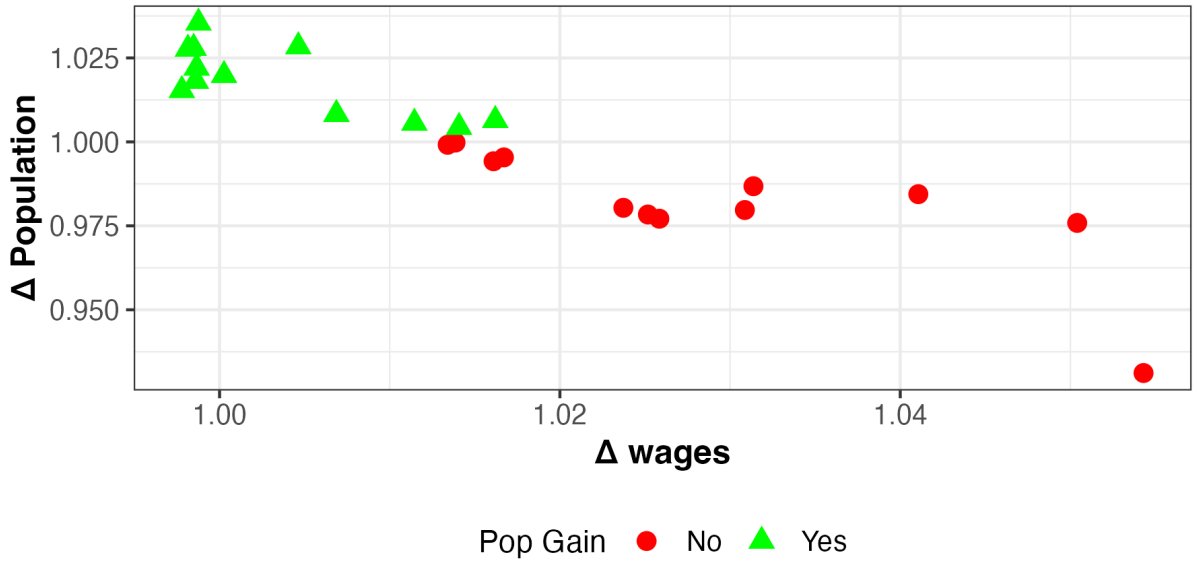
(a) Vacancy Creation with and without Migration



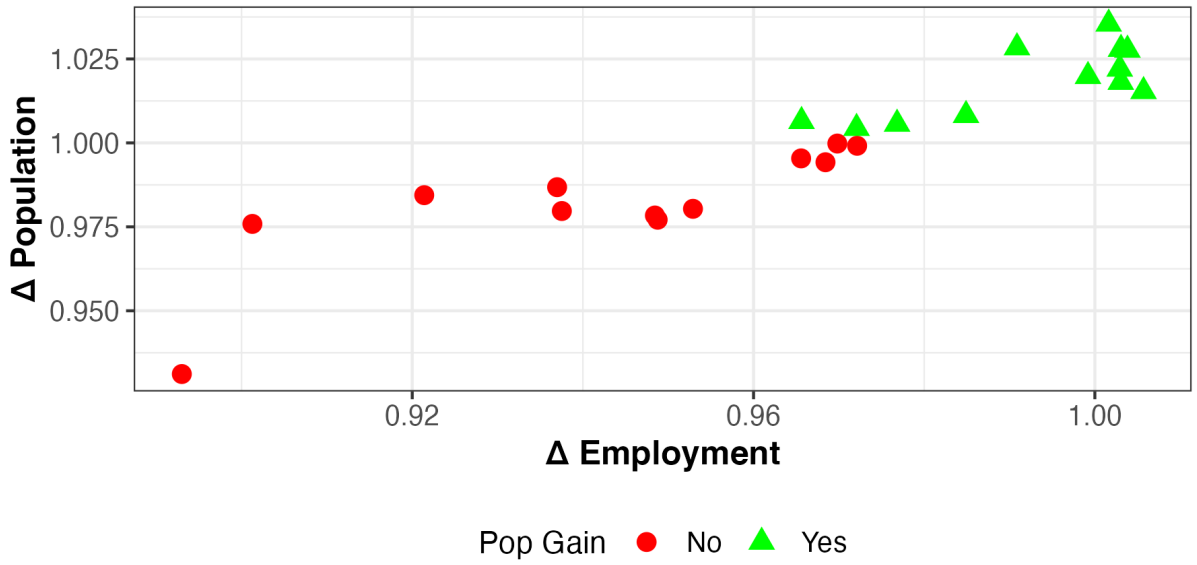
(b) Vacancy Creation by Population Change

Notes: The figure displays the change in the total number of vacancies when moving from an equilibrium without a minimum wage to one with a minimum wage.

Figure 4: Counterfactual Changes in Population



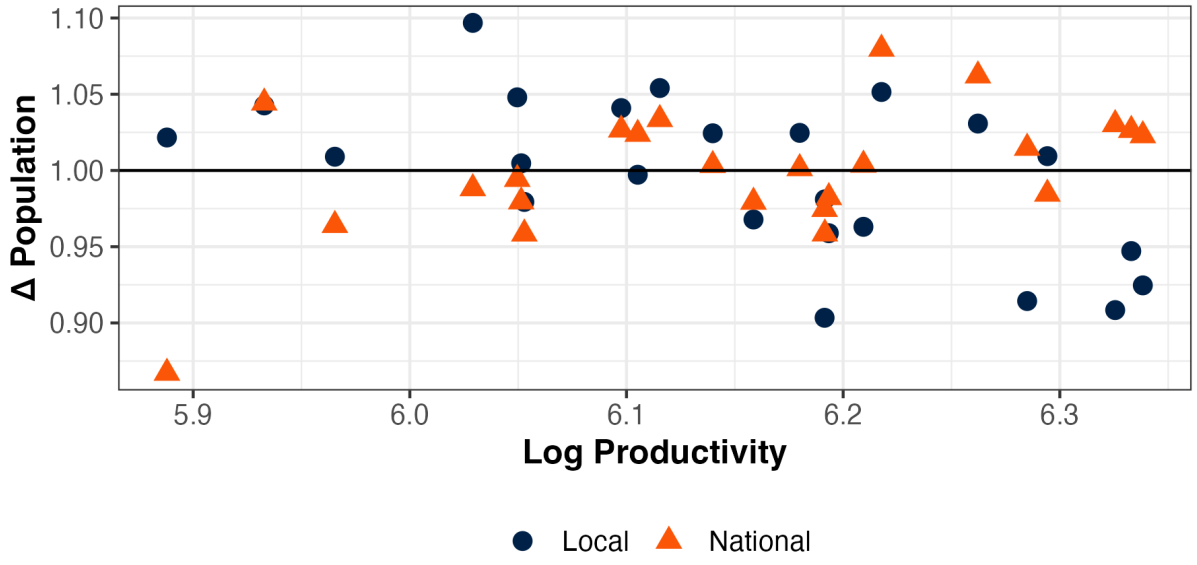
(a) The Relationship between Migration and Wages



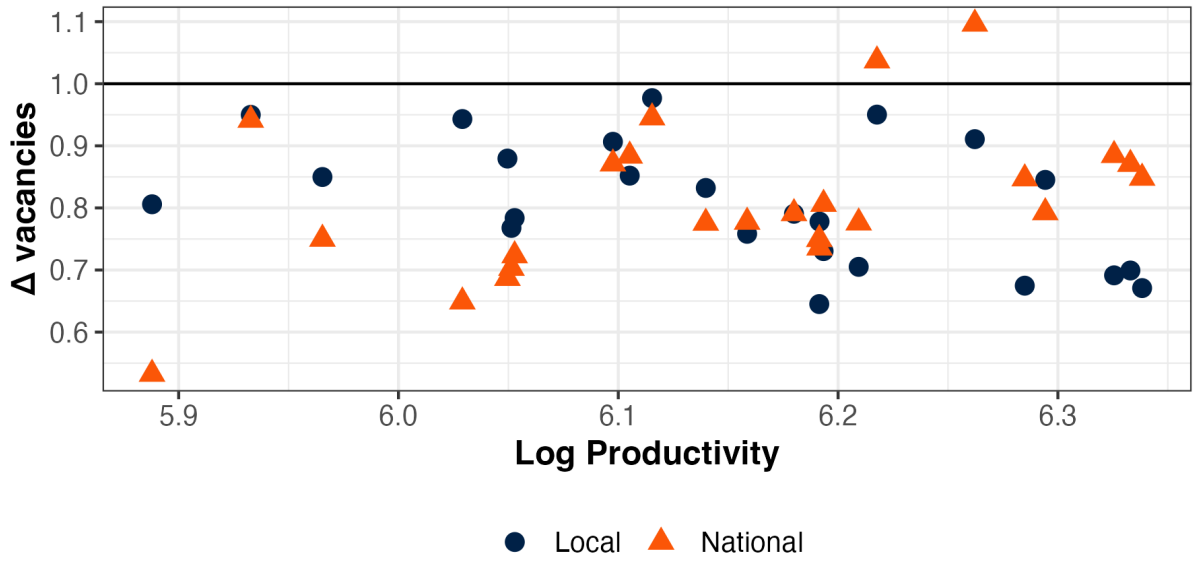
(b) The Relationship between Migration and Employment

Notes: The figure displays the changes in population against the changes in wages and employment when moving from an equilibrium without a minimum wage to one with a minimum wage.

Figure 5: Local and National Minimum Wage Policy Simulations



(a) Labor Response



(b) Firm Response

Notes: The figure displays the changes in population and vacancies for the counterfactual minimum wages that are set at the 5th percentile of local and national minimum wages, relative to the unconstrained equilibrium.

Table 1: International Migration

	Net Migration per Capita			
	(1)	(2)	(3)	(4)
log GDP per capita	0.052***	0.058***	0.079***	0.077***
	(0.012)	(0.013)	(0.013)	(0.012)
Empl to Pop Ratio		0.498***		0.613***
		(0.159)		(0.152)
Region FE	N	N	Y	Y
Countries	170	170	170	170
R^2	.107	.164	.319	.393

Notes: Region fixed effects are for global regions: Asia, Latin America, Middle East, sub-Saharan Africa, and Western offshoots. Robust standard errors in parenthesis. $^{*}p < .1, ^{**}p < .05, ^{***}p < .01$

Table 2: The Roles of Wages, Employment and Vacancies on Immigration

	Immigration Rate					log Wage	Empl Rate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
log wage	-0.003	0.012	-0.007	0.010	0.044**		
	(0.014)	(0.010)	(0.014)	(0.010)	(0.020)		
employment rate		0.212***		0.204***	0.230***		
		(0.025)		(0.026)	(0.048)		
vacancy rate			1.415***	0.517*			
			(0.496)	(0.308)			
log min wage						0.958***	0.379
						(0.354)	(0.297)
$\widehat{GAP}$						-1.222***	0.526***
						(0.242)	(0.120)
R^2	0	.555	.081	.565			
F-statistic					9.66		
Districts	119	119	119	119	119	119	119
Estimation	OLS	OLS	OLS	OLS	IV	OLS	OLS

Notes: Estimation results for the log district level immigration in the 2012 census. Robust standard errors in parenthesis. $^{*}p < .1,^{**}p < .05,^{***}p < .01$

Table 3: Estimated Match Elasticity

	log hires $/sL_o$		log hires $/s$	
	(1)	(2)	(3)	(4)
$\log(v/(sL_o))$	0.600***	0.701***		
	(0.126)	(0.161)		
$\log(v/s)$			0.601***	0.676***
			(0.127)	(0.173)
Region FE	Y	N	Y	N
Year FE	Y	N	Y	N
Regions	120	24	120	24

Notes: Reporting the estimated coefficient on $\log \theta_o$ in equation (16). Columns 1 and 3 report the two-way fixed effect regressions for the period between 2010-2014, while columns 2 and 4 report the OLS results for 2012 only. Standard errors are clustered by region. $^{*}p < .1,^{**} p < .05,^{***} p < .01$

Table 4: Simulated Parameters

Parameter	Mean (1)	Min (2)	Max (3)
y_o	5.939	5.660	6.176
σ_o	0.648	0.558	0.820
Z_o	0.029	0.006	0.070
w_{so}	19.808	16.506	22.178
δ_o	0.081	0.015	0.377
κ_o	34.910	7.663	98.756
ψ_o	0.017	0.008	0.037
Share constrained	0.009	0.000	0.046

Notes: Estimated model parameters.

Table 5: Simulated Labor Market Equilibrium with and without a Minimum Wage

	No Minimum Wage			Minimum Wage			
Outcome	Mean (1)	Min (2)	Max (3)	Mean (4)	Min (5)	Max (6)	% Change in Mean (7)
Panel A: Migration							
empl	0.178	0.097	0.466	0.176	0.088	0.467	0.987
vacancies	0.017	0.002	0.061	0.016	0.002	0.058	0.957
θ	0.465	0.068	1.79	0.447	0.059	1.743	0.959
rV^s	72.2	33.8	153.6	72.2	33.3	152.6	1.001
$\bar{w}$	73.6	34.1	159.3	73.6	33.6	158.2	1.001
ψ	0.017	0.008	0.037	0.017	0.008	0.037	1.004
avg. wage	275.8	197.5	351	280.3	208.3	350.2	1.016
surplus	660.7	118.2	2339.4	653.9	116.5	2344.4	0.990
Panel B: No Migration							
empl	0.201	0.102	0.507	0.192	0.09	0.502	0.958
vacancies	0.019	0.002	0.064	0.018	0.002	0.06	0.925
θ	0.559	0.076	2.083	0.512	0.061	1.919	0.916
rV^s	49.4	25.6	82	48.7	25.2	81.6	0.987
$\bar{w}$	49.4	25.6	82	48.7	25.2	81.6	0.987
avg. wage	261.7	194.5	310.5	269	206.4	314.5	1.028
surplus	774.8	135.9	2640.5	744.8	129.8	2616.7	0.961

Notes: Reporting the simulated equilibrium values for employment, vacancies, labor market tightness, the self-employment value, the reservation wage, the migration option value, wages, and surplus with and without a minimum wage. Column 7 reports the change in the mean value with a minimum wage relative to without. Panel A reports the simulations results allowing for migration, while Panel B does not allow for migration.

Table 6: Simulated Local versus National Minimum Wages

	Local Minimum Wage				National Minimum Wage			
Outcome	Mean (1)	Min (2)	Max (3)	% Change in Mean (4)	Mean (5)	Min (6)	Max (7)	% Change in Mean (8)
empl	0.163	0.082	0.45	0.916	0.163	0.075	0.447	0.912
vacancies	0.013	0.002	0.052	0.804	0.014	0.001	0.049	0.827
θ	0.363	0.051	1.335	0.781	0.378	0.045	1.446	0.812
rV^s	70.3	32.8	148.9	0.974	70.8	32.1	149.1	0.981
$\bar{w}$	71.7	33.1	154.3	0.975	72.2	32.5	154.5	0.981
ψ	0.017	0.008	0.037	1.008	0.017	0.008	0.036	1.009
avg. wage	290.7	211.4	358.8	1.054	292.1	224.7	347.7	1.059
surplus	615.9	100.4	2266.5	0.932	608.8	105.2	2252.8	0.921

Notes: Reporting the simulated equilibrium values under a minimum wage set at the fifth percentile of local labor market productivity in columns 1-4, and at the fifth percentile of national productivity in columns 5-8. Columns 4 and 8 report the change in the mean relative to the unconstrained equilibrium.

Table 7: Simulated Vacancy Posting Subsidy

	Locally Financed				Nationally Financed			
Outcome	Mean (1)	Min (2)	Max (3)	% Change in Mean (4)	Mean (5)	Min (6)	Max (7)	% Change in Mean (8)
empl	0.204	0.111	0.502	1.135	0.203	0.11	0.502	1.127
vacancies	0.021	0.002	0.077	1.259	0.021	0.002	0.078	1.274
θ	0.6	0.089	2.28	1.270	0.606	0.088	2.289	1.283
rV^s	58.8	29.2	87.9	1.077	58.8	29.2	88	1.077
$\bar{w}$	60.9	29.9	91.8	1.095	60.8	30.1	91.7	1.093
ψ	0.017	0.008	0.037	0.998	0.017	0.008	0.037	0.998
avg. wage	350.4	262.2	413.5	1.006	350.6	262.2	413.6	1.007
surplus	515.3	120.7	1533.8	1.129	509.7	120.8	1534.1	1.117
wage tax	0.016	0.006	0.03		0.015	0.015	0.015	

Notes: Reporting the simulated equilibrium values under a vacancy subsidy calibrated to 10% of the local cost of posting. In columns 1-4, the subsidy is financed through a local tax on employed workers, and in columns 5-8, the subsidy is financed through a national tax on employed workers. Columns 4 and 8 report the change in the mean relative to the unconstrained equilibrium.

Table 8: Comparison of Changes in Surplus across Policies

	Output	Surplus		Worker Surplus		Firm Surplus	
		Match	Total	Match	Total	Match	Total
Policy	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Actual Min Wage	0.980	1.002	0.982	1.037	1.009	0.920	0.917
Local Min Wage	0.919	1.011	0.939	1.106	1.016	0.788	0.759
National Min Wage	0.911	1.009	0.917	1.102	0.996	0.790	0.734
Local Subsidy	1.139	0.994	1.129	0.991	1.126	0.994	1.129
National Subsidy	1.131	0.991	1.117	0.988	1.113	0.991	1.117

Notes: Reporting the simulated changes relative to the unconstrained equilibrium. Column 1 reports aggregate output from wage-paying jobs, column 2 reports the average match surplus, and column 3 reports the total surplus. Columns 4-5 and 6-7 report the worker's and firm's share of match and total surplus respectively.

A Mathematical Appendix

Derivation of ψ The expected value of the option to migrate is the expected value of the maximum of the value of staying or going to the most preferred location:

$$E\left[V_o^m\right] = E\left[\max\left\{V_o^s\,,\,\zeta_o^{-1}\max_{d\neq o}\left\{\tau_{od}\zeta_d V_d^s\right\}\right\}\right]$$

Multiplying and dividing by ζ_o^{-1}, and defining the cost of not migrating as $\tau_{oo} = 1$, yields the equivalent expression for the option value in expectation:

$$E\left[V_o^m\right] = E\left[\zeta_o^{-1}\max_{d}\left\{\tau_{od}\zeta_d V_d^s\right\}\right] = E\left[\zeta_o^{-1}\right]\;E\left[\max_{d}\left\{\tau_{od}\zeta_d V_d^s\right\}\right] + cov\left(\zeta_o^{-1}\,,\,\max_{d}\left\{\tau_{od}\zeta_d V_d^s\right\}\right)$$

Appealing to the relationship between extreme value distributions that if ζ_d $\sim$Frechect(ϕ), then ζ_o^{-1} $\sim$Weibull(ϕ), the expression reduces to:

$$E[V_o^m] = \left(\sum_d \left(\tau_{od}V_d^s\right)^\phi\right)^{\frac{1}{\phi}}\Gamma\left(1-\frac{1}{\phi}\right)\Gamma\left(1+\frac{1}{\phi}\right) + cov\left(\zeta_o^{-1}\,,\,\max_{d}\left\{\tau_{od}\zeta_d V_d^s\right\}\right)$$

$$E[V_o^m] = \left(\sum_d \left(\tau_{od}V_d^s\right)^\phi\right)^{\frac{1}{\phi}}\frac{\pi/\phi}{\sin(\pi/\phi)} + cov\left(\zeta_o^{-1}\,,\,\max_{d}\left\{\tau_{od}\zeta_d V_d^s\right\}\right)$$

Where $\Gamma(\cdot)$ is the Gamma function, which has the property: $\Gamma(1-a)\Gamma(1+a) = a\pi/\sin(a\pi)$. Since the ζ_d are independent across locations, the covariance term is zero whenever $d \neq o$. When $d = o$, or the individual chooses not to migrate, it reduces to:

$$cov\left(\zeta_o^{-1}\,,\,\zeta_o V_o^s\right) = E\left[\zeta_o^{-1}\zeta_o V_o^s\right] - E\left[\zeta_o^{-1}\right]E\left[\zeta_o V_o^s\right] = V_o^s\left(1-\frac{\pi/\phi}{\sin(\pi/\phi)}\right)$$

The probability that the individual chooses not to migrate, or that $d = o$, is the probability that the value of staying exceeds the value of migrating to all other locations:

$$Pr\left[V_o^s \geq \zeta_o^{-1}\max_{d\neq o}\left\{\tau_{od}\zeta_d V_d^s\right\}\right] = Pr\left[\zeta_o V_o^s = \max_{d}\left\{\tau_{od}\zeta_d V_d^s\right\}\right] = \frac{\left(V_o^s\right)^\phi}{\sum_d\left(\tau_{od}V_d^s\right)^\phi}$$

Define the constant:

$$\mathit{\Gamma} = \frac{\pi/\phi}{\sin(\pi/\phi)}$$

Then $E[V_o^m]$ is:

$$\begin{aligned}
E[V_o^m] =& \left(\sum_d \left(\tau_{od} V_d^s\right)^\phi\right)^{\frac{1}{\phi}} \Gamma + \left(\frac{(V_o^s)^\phi}{\sum_d \left(\tau_{od} V_d^s\right)^\phi}\right) \left(V_o^s \left(1-\Gamma\right)\right) \\
E[V_o^m] =& V_o^s \left(\Gamma \left(\sum_d \left(\frac{\tau_{od} V_d^s}{V_o^s}\right)^\phi\right)^{\frac{1}{\phi}} + \left(1-\Gamma\right) \frac{(V_o^s)^\phi}{\sum_d \left(\tau_{od} V_d^s\right)^\phi}\right) \\
E[V_o^m] =& V_o^s (1+\psi_o)
\end{aligned}$$

Where

$$\psi_o = \left(\Gamma \left(\sum_d \left(\frac{\tau_{od} V_d^s}{V_o^s}\right)^\phi\right)^{\frac{1}{\phi}} + \left(1-\Gamma\right) \frac{(V_o^s)^\phi}{\sum_d \left(\tau_{od} V_d^s\right)^\phi}\right) - 1$$

Appealing to the fact that the probability of choosing d is the share of individuals who choose to migrate to d from o, we can express the migration shares as:

$$\pi_{od} = \left(\frac{(\tau_{od} V_d^s)^\phi}{\sum_d \left(\tau_{od} V_d^s\right)^\phi}\right)$$

Using this definition, we can equivalently express ψ_o in terms of the share of workers who choose not to migrate:

$$\psi_o = \left(\Gamma \pi_{oo}^{\frac{-1}{\phi}} + \left(1-\Gamma\right) \pi_{oo}\right) - 1$$

Continuous Time Representation For ease of exposition, let $\lambda = p_o \theta_o q_o(\theta_o)$ and omit the o subscript. Appealing to the fact that $E[V_{t+1}^m] = V_{t+1}^s(1+\psi_{t+1})$, the value function for self-employment can be expressed as:

$$V_t^s = w_{st} + (1-r)\Big(\lambda_{t+1} \int_{w_{t+1}} V_{t+1}(w_{t+1}) \partial F(w_{t+1}) + (1-\lambda_{t+1}) V_{t+1}^s (1+\psi_{t+1})\Big)$$

Let $\Delta = \partial t$. Then we can express the unit of interval as:

$$\begin{aligned}
V_t^s =& w_{st}\Delta + (1-r\Delta)\Big(\Delta\lambda_{t+\Delta} \int_{w_{t+\Delta}} V_{t+\Delta}(w_{t+\Delta}) \partial F(w_{t+\Delta}) + (1-\Delta\lambda_{t+\Delta}) V_{t+\Delta}^s (1+\Delta\psi_{t+\Delta})\Big) \\
\frac{V_t^s - V_{t+\Delta}^s}{\Delta} =& w_{st} + \lambda_{t+\Delta}\Big(\int_{w_{t+\Delta}} V_{t+\Delta}(w_{t+\Delta}) \partial F(w_{t+\Delta}) - V_{t+\Delta}^s (1+\Delta\psi_{t+\Delta})\Big) + V_{t+\Delta}^s \psi_{t+\Delta} \\
& - r\Big(\Delta\lambda_{t+\Delta} \int_{w_{t+\Delta}} V_{t+\Delta}(w_{t+\Delta}) \partial F(w_{t+\Delta}) + (1-\Delta\lambda_{t+\Delta}) V_{t+\Delta}^s (1+\Delta\psi_{t+\Delta})\Big)
\end{aligned}$$

Then, taking the limit as $\Delta \to 0$, and using the dot notation to express the left hand side of the above equation as the change yields, and rearranging yields the continuous time representation:

$$\begin{aligned} rV_t^s =& w_{st} + \dot{V}_t^s + \lambda_t \Big(\int_{w_t} V_t(w_t) \partial F(w_t) - V_t^s \Big) + V_t^s \psi_t \\ rV_t^s =& w_{st} + \dot{V}_t^s + \lambda_t \Big(\int_{w_t} V_t(w_t) \partial F(w_t) - V_t^m \Big) + V_t^s \psi_t (1 + \lambda_t) \end{aligned}$$

Then in steady state we have:

$$rV_o^s = w_{so} + V_o^s \psi_o (1 + p_o \theta_o q_o(\theta_o)) + p_o \theta_o q_o(\theta_o) \Big(\int_{w_o} V_o(w) \partial F(w_o) - V_o^m \Big)$$

Similarly, the value of employment at wage w in continuous time can be derived as:

$$\begin{aligned} V_t(w) =& w\Delta + (1 - r\Delta) \left(\delta \Delta V_{t+\Delta}^m + (1 - \delta\Delta) V_{t+\Delta}(w) \right) \\ \frac{V_t(w) - V_{t+\Delta}(w)}{\Delta} =& w + \delta \left(V_{t+\Delta}^m - V_{t+\Delta}(w) \right) - r \left(\delta \Delta V_{t+\Delta}^m + (1 - \delta\Delta) V_{t+\Delta}(w) \right) \end{aligned}$$

Then taking the limit as $\Delta \to 0$:

$$rV_{o,t}(w) = w + \dot{V}_{o,t}(w) + \delta \left(V_{o,t}^m - V_{o,t}(w) \right)$$

In steady state this can be arranged as:

$$V_o(w) = \frac{w + \delta_o V_o^m}{r + \delta_o}$$

Then the reservation wage is determined by the wage at which the worker is indifferent between accepting and rejecting: $V_o(\bar{w}_o) = V_o^m$

$$\frac{\bar{w}_o + \delta_o V_o^m}{r + \delta_o} = V_o^m \implies \bar{w}_o = rV_o^m = (1 + \psi_o) r V_o^s$$

Then we can define the probability of accepting (p_o) as:

$$p_o = 1 - F_o((1 + \psi_o) r V_o^s)$$

The realization of y occurs after the match, so p_o is only relevant once the match occurs. For firms, the value of posting a vacancy is:

$$V_t = -\kappa_o + (1 - r) \left(q_o(\theta_{o,t+1}) \left(p_{o,t+1} J_{t+1} \right) + (1 - q_o(\theta_{o,t+1})) V_{t+1} \right)$$

To express the value of posting a vacancy in continuous time, again put $\Delta = \partial t$. Then we can express

the unit of interval as:

$$\begin{aligned} V_t =& -\kappa_o\Delta + (1-r\Delta)\left(q_o(\theta_{o,t+\Delta})p_{o,t+\Delta}\Delta J_{t+\Delta} + (1-q_o(\theta_{o,t+\Delta})\Delta)V_{t+\Delta}\right) \\ \frac{V_t - V_{t+\Delta}}{\Delta} =& -\kappa_o + q_o(\theta_{o,t+\Delta})\left(p_{o,t+\Delta}J_{t+\Delta} - V_{t+\Delta}\right) \\ & - r\left(q_o(\theta_{o,t+\Delta})p_{o,t+\Delta}\Delta J_{t+1} + (1-q_o(\theta_{o,t+\Delta})\Delta)V_{t+\Delta}\right) \end{aligned}$$

Then taking the limit as $\Delta \to 0$:

$$-\dot{V}_t = -\kappa_o + q_o(\theta_{o,t})\left(p_{o,t}J_t - V_t\right) - rV_t$$

In steady state, $\dot{V}_t = 0$:

$$rV_t = -\kappa_o + q_o(\theta_{o,t})\left(p_{o,t}J_t - V_t\right)$$

Similarly, the value of a job conditional upon a match is:

$$\begin{aligned} J_t =& y - w + (1-r)\left((1-\delta)J_{t+1}\right) \\ J_t =& (y-w)\Delta + (1-r\Delta)\left((1-\delta\Delta)J_{t+\Delta}\right) \\ \frac{J_t - J_{t+\Delta}}{\Delta} =& (y-w) - \delta J_{t+\Delta} - r\left((1-\delta\Delta)J_{t+\Delta}\right) \\ -\dot{J}_t =& (y-w) - \delta J_t - rJ_t \\ J_t =& \frac{(y-w)+\dot{J}_t}{r+\delta} \end{aligned}$$

In steady state:

$$J_t = \frac{y-w}{r+\delta}$$

Wage Bargaining The value to a worker of a match is $V_o(w) - V_o^m$.

$$\begin{aligned} V_o(w) - V_o^m =& \frac{w - rV_o^m}{r+\delta_o} \\ w =& \arg\max \left(\frac{w - rV_o^m}{r+\delta_o}\right)^{\eta}\left(\frac{y-w}{r+\delta_o}\right)^{1-\eta} \\ w^* =& (1-\eta)rV_o^m + \eta y \end{aligned}$$

And we can reduce the expected value of a match as

$$\begin{aligned} E[y - w(y)|w(y) \geq \bar{w}_o] =& E[y - (1-\eta)rV_o^m - \eta y|(1-\eta)rVmu_o + \eta y \geq rV_o^m] \\ =& (1-\eta)E[y - rV_o^m|\eta y \geq \eta rV_o^m] \\ =& (1-\eta)\left(E[y|y \geq rV_o^m] - rV_o^m\right) \\ =& (1-\eta)\left(\int_{(1+\psi_o)rV_o^s} y\,\partial F_o(y) - rV_o^m\right) \end{aligned}$$

Equilibrium Value Functions The value of self-employment can be expressed in terms of the expected job productivity (y) as:

$$rV_o^s = w_{so} + V_o^s\psi_o(1 + p_o\theta_o q_o(\theta_o)) + p_o\theta_o q_o(\theta_o)\left(E[V_o(w(y))|y \geq \bar{w}_o] - V_o^m\right)$$

Where

$$E[V_o(w(y))|y \geq \bar{w}_o] = E\left[\frac{(1-\eta)rV_o^m + \eta y + \delta_o V_o^m}{r+\delta_o}\,\middle|\, y \geq \bar{w}_o\right] = \frac{\eta}{r+\delta_o}\left(E\left[y|y \geq \bar{w}_o\right] - rV_o^m\right) + V_o^m$$

Then the value of self-employment can be expressed as:

$$rV_o^s = w_{so} + V_o^s\psi_o(1 + p_o\theta_o q_o(\theta_o)) + \frac{\eta p_o\theta_o q_o(\theta_o)}{(r+\delta_o)}\left(E\left[y|y \geq \bar{w}_o\right] - (1+\psi_o)rV_o^s\right)$$

Define

$$A(\theta_o, \psi_o) = \left(\frac{(r+\delta_o)}{r+\delta_o+\eta p_o\theta_o q_o(\theta_o)(1+\psi_o)}\right)$$

Moving rV_o^s to the other side yields:

$$rV_o^s = A(\theta_o,\psi_o)\left(w_{so} + V_o^s\psi_o(1 + p_o\theta_o q_o(\theta_o))\right) + (1 - A(\theta_o,\psi_o))\frac{E\left[y|y \geq \bar{w}_o\right]}{(1+\psi_o)}$$

Define

$$\Upsilon_o(\theta_o,\psi_o) = \frac{r}{r - A(\theta_o,\psi_o)\psi_o(1 + p_o\theta_o q_o(\theta_o))}$$

Then the value of self-employment can be expressed in closed form as:

$$rV_o^s = \Upsilon_o(\theta_o,\psi_o)\left(A(\theta_o,\psi_o)w_{so} + (1 - A(\theta_o,\psi_o))\frac{E\left[y|y \geq \bar{w}_o\right]}{(1+\psi_o)}\right)$$

A.1 Minimum Wage

We first consider a single minimum wage for each location. Define $\hat{y}_o$ as the productivity level for which the equilibrium wage equals the minimum wage ($m_o = \eta\hat{y}_o + (1-\eta)rV_o^m$). Then $\hat{y}_o$ can be expressed in terms of the minimum wage as:

$$\hat{y}_o = m_o + \frac{(1-\eta)}{\eta}(m_o - rV_o^m)$$

By assumption, the minimum wage is not enforced in jobs whose realized productivity is less than m_o. Define $\hat{w}(y|m_o)$ as the mapping from productivity to wages with a minimum wage such that:

$$\hat{w}(y|m_o) = \begin{cases} w(y) & \text{if} \quad y < m_o \\ m_o & \text{if} \quad y \in [m_o, \hat{y}_o] \\ w(y) & \text{if} \quad y > \hat{y}_o \end{cases}$$

Then we can define the expected value of a job with the minimum wage as:

$$\begin{aligned}E[V_o(\hat{w}(y|m_o))] =& E[V_o(w(y))|y < m_o] + E[V_o(m_o)|m_o < y \leq \hat{y}_o] + E[V_o(w(y))|y > \hat{y}_o] \\ E[V_o(\hat{w}(y|m_o))] =& E[V_o(w(y))] + E[V_o(m_o)|m_o < y \leq \hat{y}_o] - E[V_o(w(y))|m_o < y \leq \hat{y}_o]\end{aligned}$$

The second two terms are:

$$\begin{aligned}E[V_o(m_o) - V_o(w(y))|m_o < y \leq \hat{y}_o] =& E\left[\frac{m_o + \delta_o V_o^m}{r+\delta_o} - \frac{w + \delta_o V_o^m}{r+\delta_o}\middle| m_o < y \leq \hat{y}_o\right] \\ E[V_o(m_o) - V_o(w(y))|m_o < y \leq \hat{y}_o] =& \frac{\eta}{r+\delta_o}(\hat{y}_o - E[y|m_o < y \leq \hat{y}_o])\end{aligned}$$

Then the expected value of a job with a minimum wage is:

$$\begin{aligned}E[V_o(\hat{w}(y|m_o))] =& E[V_o(w(y))] + \frac{\eta}{r+\delta_o}(\hat{y}_o - E[y|m_o < y \leq \hat{y}_o]) \\ E[V_o(\hat{w}(y|m_o))] =& \frac{\eta}{r+\delta_o}\left(E\left[y|y \geq \bar{w}_o\right] - rV_o^m + \hat{y}_o - E[y|m_o < y \leq \hat{y}_o]\right) + V_o^m\end{aligned}$$

Then the value of self-employment can be expressed as:

$$\begin{aligned}rV_o^s =& w_{so} + V_o^s\psi_o(1 + p_o\theta_o q_o(\theta_o)) + p_o\theta_o q_o(\theta_o) \\ & \left(\frac{\eta}{r+\delta_o}\left(E\left[y|y \geq \bar{w}_o\right] - rV_o^m + \hat{y}_o - E[y|m_o < y \leq \hat{y}_o]\right) + V_o^m - V_o^m\right) \\ rV_o^s =& A(\theta_o, \psi_o)\left(w_{so} + V_o^s\psi_o(1 + p_o\theta_o q_o(\theta_o))\right) + (1 - A(\theta_o, \psi_o))\frac{\left(E\left[y|y \geq \bar{w}_o\right] + \hat{y}_o - E[y|m_o < y \leq \hat{y}_o]\right)}{(1+\psi_o)}\end{aligned}$$

And the closed form solution is:

$$rV_o^s = \Upsilon_o(\theta_o, \psi_o)\left(A(\theta_o, \psi_o)w_{so} + (1 - A(\theta_o, \psi_o))\frac{\left(E\left[y|y \geq \bar{w}_o\right] + \hat{y}_o - E[y|m_o < y \leq \hat{y}_o]\right)}{(1+\psi_o)}\right)$$

Vacancy Creation with a Minimum Wage The value of a filled job with a minimum wage is:

$$J_o(y, m_o) = \begin{cases} \frac{y - w(y)}{r+\delta_o} & \text{if} \quad y < m_o \\ \frac{y - m_o}{r+\delta_o} & \text{if} \quad y \in [m_o, \hat{y}_o] \\ \frac{y - w(y)}{r+\delta_o} & \text{if} \quad y > \hat{y}_o \end{cases}$$

In expectation:

$$\begin{aligned}E[J_o(y, m_o)|y \geq \bar{w}_o] =& E\left[\frac{y - w(y)}{r+\delta_o}|\bar{w}_o \leq y < m_o\right] + E\left[\frac{y - m_o}{r+\delta_o}|\bar{w}_o \leq y < \hat{y}_o\right] + E\left[\frac{y - w(y)}{r+\delta_o}|\hat{y}_o < y\right] \\ E[J_o(y, m_o)|y \geq \bar{w}_o] =& E\left[\frac{y - w(y)}{r+\delta_o}|\bar{w}_o \leq y\right] + E\left[\frac{y - m_o}{r+\delta_o}|\bar{w}_o \leq y < \hat{y}_o\right] - E\left[\frac{y - w(y)}{r+\delta_o}|\bar{w}_o \leq y < \hat{y}_o\right] \\ E[J_o(y, m_o)|y \geq \bar{w}_o] =& \frac{1}{r+\delta_o}\left((1-\eta)\left(E\left[y|\bar{w}_o \leq y\right] - \bar{w}_o\right) + \eta\left(E\left[y|\bar{w}_o \leq y < \hat{y}_o\right] - \hat{y}_o\right)\right)\end{aligned}$$

In equilibrium, vacancy creation is determined by:

$$\frac{\kappa_o}{q(\theta_o)} = \frac{p_o\left((1-\eta)\left(E\left[y|\bar{w}_o \leq y\right] - \bar{w}_o\right) + \eta\left(E\left[y|\bar{w}_o \leq y < \hat{y}_o\right] - \hat{y}_o\right)\right)}{(r+\delta_o)}$$

Appealing to the definition of $q(\theta_o) = A_o(v_o/(s_o L_o))^{-\alpha}$ and rearranging, vacancy creation with a minimum wage can be expressed as:

$$v_o = s_o L_o \left(\frac{A_o p_o\left((1-\eta)\left(E\left[y|\bar{w}_o \leq y\right] - \bar{w}_o\right) - \eta\left(\hat{y}_o - E\left[y|\bar{w}_o \leq y < \hat{y}_o\right]\right)\right)}{\kappa_o(r+\delta_o)}\right)^{\frac{1}{\alpha}}$$

A.2 Vacancy subsidy

In this section, we consider a subsidy on the cost of posting a vacancy (φ_o), which may vary across locations, which is subsidized by a tax (τ_o). The value of a job to a worker is $V_o(w|\tau_o) = (w(1-\tau_o) + \delta_o E[V_o^m])/(r+\delta_o)$. The wage with the tax is now determined by:

$$w(y|\tau_o) = \arg\max \left(\frac{w(1-\tau_o) - rE[V_o^m]}{r+\delta_o}\right)^{\eta} \left(\frac{y-w}{r+\delta_o}\right)^{1-\eta}$$

Differentiating with respect to w implies:

$$w^*(y|\tau_o) = \eta y + (1-\eta)\frac{rE[V_o^m]}{(1-\tau^w)}$$

Define the tax policy as $\tau = \{\tau_1, \ldots, \tau_o, \ldots, \tau_D\}$. Then the present value of self-employment in o under tax policy τ is:

$$rV_o^s(\tau) = w_{so} + V_o^s(\tau)\psi_o(1 + p_o\theta_o q_o(\theta_o)) + p_o\theta_o q_o(\theta_o)\left(E[V_o(w(y|\tau_o))] - E[V_o^m]\right)$$

Where:

$$\begin{aligned} E[V_o(w(y))] =& \frac{\eta}{r+\delta_o}\left((1-\tau^w)E\left[y|y \geq \bar{w}_o\right] - rE[V_o^m]\right) + E[V_o^m] \\ E[V_o^m] =& (1+\psi_o)V_o^s \end{aligned}$$

Substituting and appealing to the definitions of $A(\theta_o, \psi_o)$ and Υ_o, the present value of self-employment can be expressed as:

$$rV_o^s = \Upsilon_o\left(A(\theta_o,\psi_o)w_{so} + (1 - A(\theta_o,\psi_o))\frac{(1-\tau^w)E\left[y|y \geq \bar{w}_o\right]}{(1+\psi_o)}\right)$$

The present value of posting a vacancy is:

$$rV = -\kappa_o + \varphi_o + q_o(\theta_o)(p_o E[J] - V)$$

Where the expected value of a filled job is:

$$E[J] = \frac{E[y - w(y|\tau_o)|w(y|\tau_o) \geq \bar{w}_o]}{r + \delta_o} = \left(\frac{(1-\eta)}{r+\delta_o}\right) E[y - \frac{(1+\psi_o)rV_o^s}{(1-\tau_o)}|w(y|\tau_o) \geq \bar{w}_o]$$

And

$$w(y|\tau_o) \geq \bar{w}_o \qquad \implies (1-\eta)\frac{(1+\psi_o)rV_o^s}{(1-\tau_o)} + \eta y \geq \frac{(1+\psi_o)rV_o^s}{(1-\tau_o)} \qquad \implies y \geq \bar{w}_o$$

Then the present value of posting a vacancy can be expressed as:

$$rV = -\kappa_o + \varphi_o + q_o(\theta_o)\left(p_o\left(\frac{(1-\eta)}{r+\delta_o}\right)\left(E[y|y \geq \bar{w}_o] - \frac{(1+\psi_o)rV_o^s}{(1-\tau_o)}\right) - V\right)$$

Under the assumption that an unfilled vacancy has zero value:

$$\kappa_o - \varphi_o = q_o(\theta_o)\left(p_o\left(\frac{(1-\eta)}{r+\delta_o}\right)\left(E[y|y \geq \bar{w}_o] - \frac{(1+\psi_o)rV_o^s}{(1-\tau^w)}\right)\right)$$

Which can be rearranged to solve for the total number of vacancies in o:

$$v_o = s_o L_o \left(\frac{A_o p_o (1-\eta)\left(E[y|y \geq \bar{w}_o] - \bar{w}_o\right)}{(\kappa_o - \tau^v)(r+\delta_o)}\right)^{\frac{1}{\alpha}}$$

The equilibrium tax on wages under the national tax system is obtained through the government budget balance condition:

$$\begin{aligned}
\sum_o v_o\varphi_o &= \sum_o (1-s_o)L_o \int_{\bar{w}_o}^{\infty} w(y|\tau_o)\tau_o \\
\sum_o v_o\varphi_o &= \sum_o (1-s_o)L_o\tau_o\left(\eta\int_{\bar{w}_o}^{\infty} y\partial F_o(y) + (1-\eta)\bar{w}_o\right) \\
\tau_o = \tau &= \frac{\sum_o v_o\varphi_o}{\sum_o (1-s_o)L_o\left(\eta\int_{\bar{w}_o}^{\infty} y\partial F_o(y) + (1-\eta)\bar{w}_o\right)}
\end{aligned}$$

Similarly, a subsidy financed through a tax on local wages must satisfy:

$$(1-s_o)L_o\int_{\bar{w}_o}^{\infty} w(y|\tau_o)\tau_o = v_o\varphi_o\,, \qquad \forall\, o$$

Which implies that the local tax on wages is determined by:

$$\tau_o = \frac{v_o\varphi_o}{(1-s_o)L_o\left(\eta\int_{\bar{w}_o}^{\infty} y\partial F_o(y) + (1-\eta)\bar{w}_o\right)}$$

B Minimum Wage Law

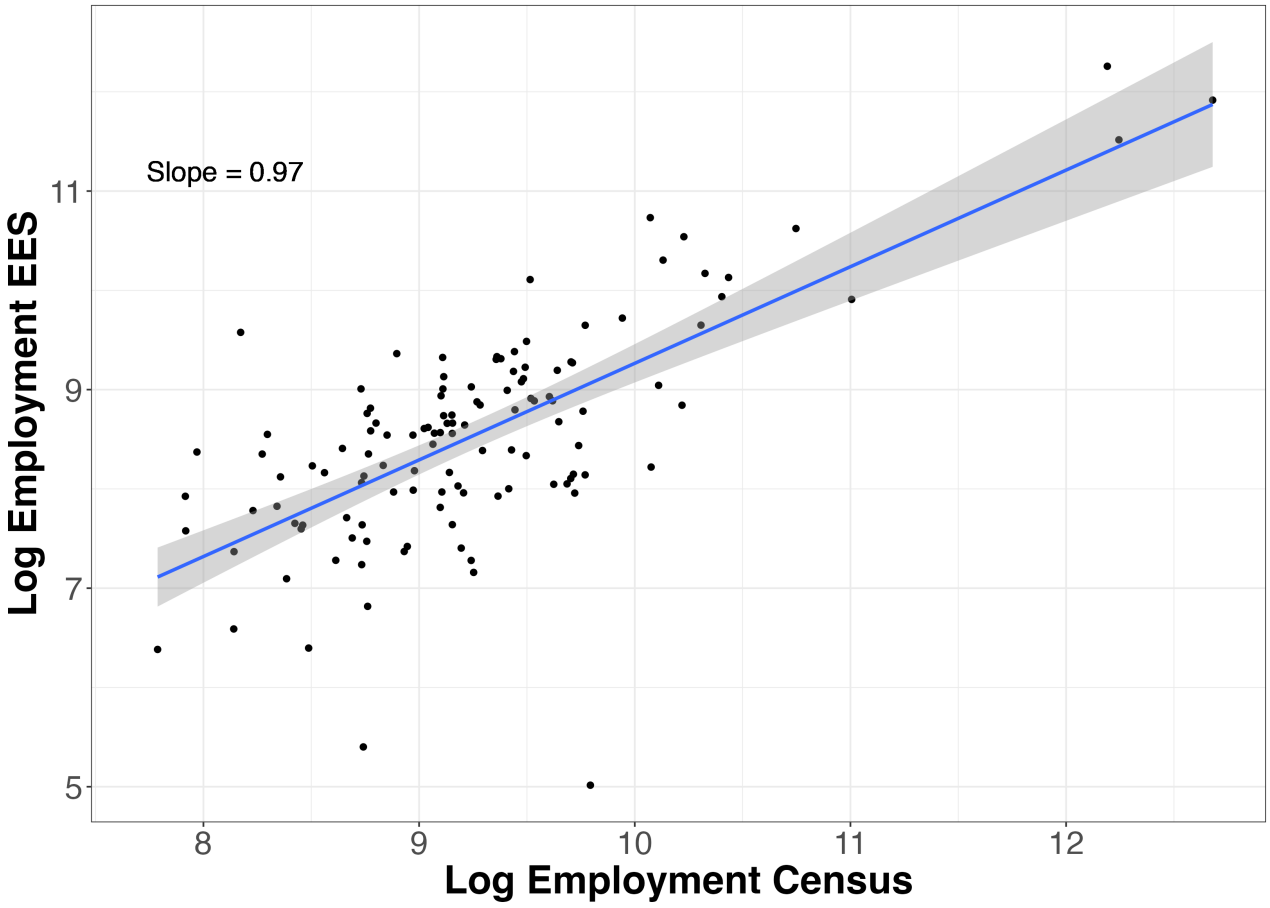
Tanzania's Employment and Labour Relations Act, 2004 set forth a broad set of regulations "to promote economic development through economic efficiency, productivity and social justice" (p. 6). The act applied to all laborers in the country, both public and private, except for those in the People's Defence force, the police force, prison services and the national service (Employment and Labour Relations Act, 2004, p. 5). The legislation made it illegal for children under the age of 14 to work (and under the age of 18 in hazardous sectors). The maximum number of usual hours that an employee could work were set at 9 hours per day, 6 days per week and 45 hours per week (p. 19). The penalty for violating these laws was up to one year in jail and a 5 million shilling fine (p. 79). The legislation did not set an official binding minimum wage, but made a provision to set one within three years, laying the groundwork for creating a national minimum wage (p. 84).

Progress continued with the 2007 Labour Institutions Act, which allowed for the creation of sectoral wage boards that would determine the minimum wage within their sector. In 2010, minimum wages were passed into law in eight sectors. I report the monthly minimum wages for these sectors in Column 2 of Table A.2. Each minimum wage stipulated an hourly, daily, weekly, fortnightly, and monthly rate. Adding further complexity, several sectors provided different levels for subsectors, creating 20 total minimum wages. The differences within sectors could be large; for domestic and hospital services the monthly minimum wage ranged from 65,000 TSH for domestic workers to 150,000 TSH for tourist hotels. Employers in any sector not mentioned were required to pay all employees at least 80,000 TSH per month for full time work. The "all other sectors" minimum wage equalled that for health services and commerce, industry, and trade, and exceeded the minimum wage for agriculture (70,000 TSH per month) and domestic workers (65,000 TSH per month).

These sectoral minimum wages remained in place until July 2013 when the 2010 Wage Order was repealed and replaced. The new Wage Order increased the minimum wage in all sectors that were covered in the 2010 and created sectoral minimum wages for eight additional sectors. Sectors that were added in the 2013 Wage Order are noted by an X in Column 1 of Table A.2. The sectoral minimum wages for those sectors were not increased proportionally. In Column 4 of Table A.2, I report the percentage increase in the minimum wage for each sector. Among sectors that were covered in 2010, the change varied from -38% for other domestic workers to 66.7% for tourist hotels and domestic workers employed by diplomats. Outside of domestic and hospital services the largest changes were for health services (+65%) to aviation services (-14.3%). For sectors that were all newly covered in 2013, the effective minimum wage in those sectors increased by at least 75%, while the national minimum wage rose by 25%. The variation in these changes are displayed In Figure **??**, where I plot the minimum wage in each sector relative to the national minimum wage in 2010 and 2013.

C Additional Figures and Tables

Figure A.1: District Employment in the EES and Census



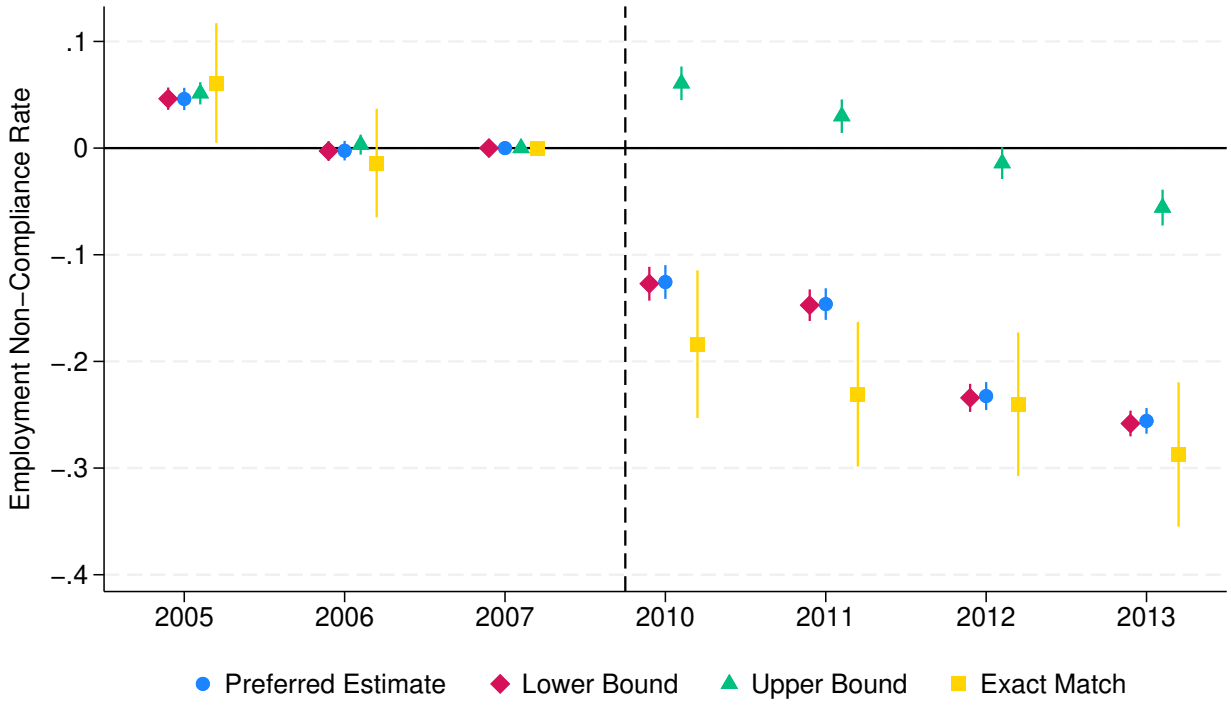
Notes: Displaying log employment in 2012 by district as measured using the EES and Census. All values are weighted by their respective survey weights.

Figure A.2: Average Monthly Wage in Three Datasets



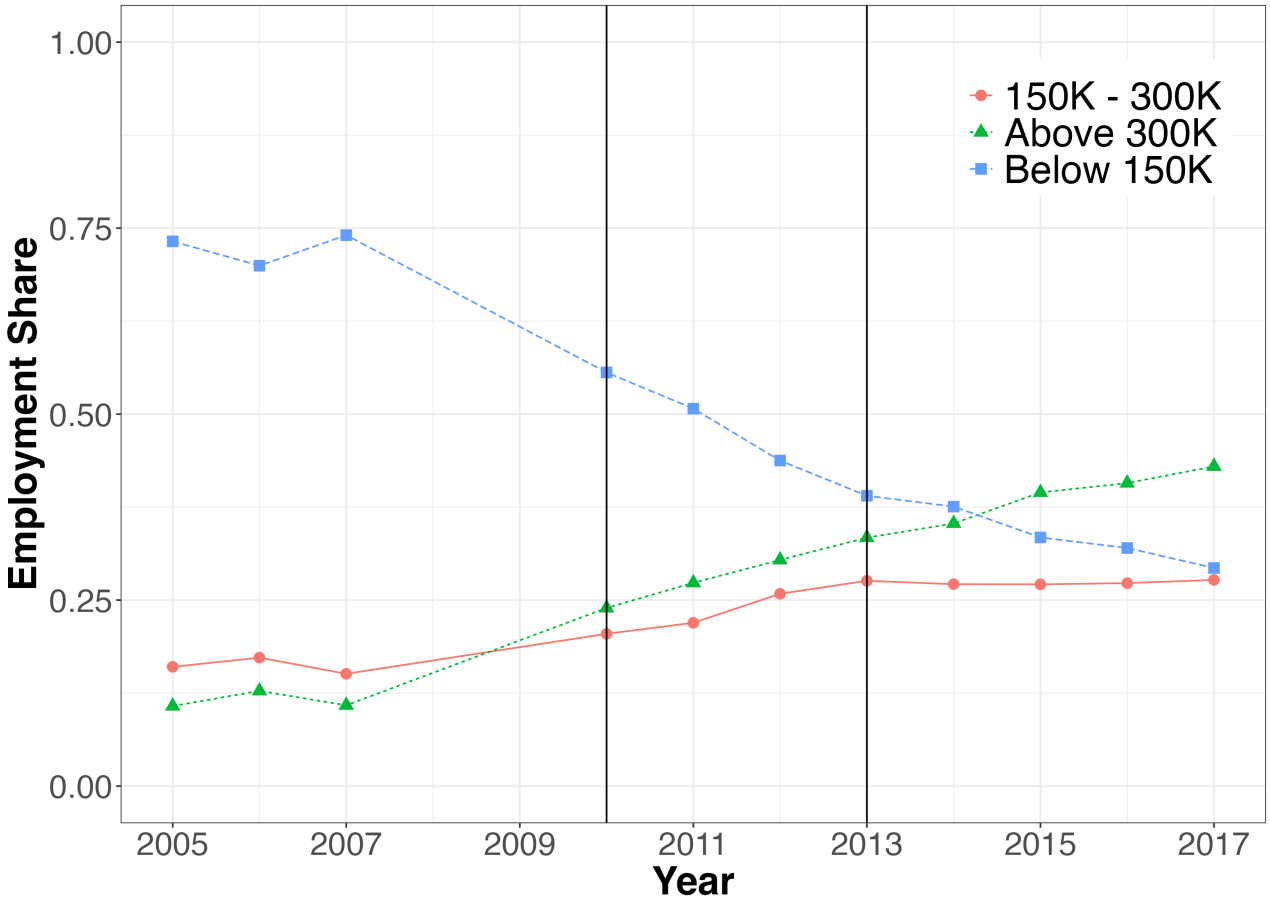
Notes: Plotting the distribution of log nominal mean wages across districts in the three datasets. All values are weighted by their respective survey weights. Excluding casual workers and public employers.

Figure A.3: Employment Minimum Wage Non-Compliance Event Study



Notes: Reporting the ENC coefficient estimates relative to the base year and 95% confidence intervals from equation (1). $N = 67,010$ firm-year observations. All regressions include district and sector fixed effects and are weighted using survey weights. The dashed line indicates the introduction of the 2010 minimum wage law.

Figure A.4: Employment Share by Wage Band



Notes: Displaying the share of workers earning below 150,000 TSH, 150,000 - 300,000, and greater than 300,000 per month. The black lines indicates the date when the minimum wage laws were enacted. The sample does not include domestic workers, so the effective minimum wage in 2010 and 2013 is 70,000 and 100,000 TSH, respectively.

Table A.1: Firm Monthly Wage Summary Statistics

Year	All Employees			Private Sector Employees		
	Min Wage	Wage	Wage + Inkind	Min Wage	Wage	Wage + Inkind
	(1)	(2)	(3)	(4)	(5)	(6)
2005	0.0	259.4	308.7	0.0	212.8	266.8
	(0.0)	(3.9)	(4.7)	(0.0)	(6.1)	(7.6)
2006	0.0	297.4	369.9	0.0	233.1	304.1
	(0.0)	(3.6)	(4.4)	(0.0)	(6.3)	(7.8)
2007	0.0	260.8	318.6	0.0	198.0	260.8
	(0.0)	(3.6)	(4.4)	(0.0)	(5.9)	(7.3)
2010	86.4	343.4	383.6	89.6	256.6	300.3
	(0.4)	(3.8)	(4.6)	(0.6)	(4.8)	(6.0)
2011	75.9	332.9	372.7	78.6	254.0	289.9
	(0.4)	(3.6)	(4.4)	(0.6)	(4.7)	(5.8)
2012	66.1	349.4	389.7	68.4	306.7	344.1
	(0.3)	(3.3)	(4.1)	(0.5)	(4.2)	(5.2)
2013	61.3	359.5	389.7	63.4	321.4	356.2
	(0.3)	(3.1)	(3.8)	(0.5)	(3.8)	(4.7)
2014	90.6	371.0	396.6	95.1	320.6	350.7
	(0.3)	(2.9)	(3.5)	(0.4)	(3.6)	(4.4)
2015	86.4	406.0	449.7	89.5	325.1	361.2
	(0.3)	(2.7)	(3.3)	(0.4)	(3.3)	(4.1)
2016	83.8	415.7	486.4	87.2	332.2	384.2
	(0.2)	(2.5)	(3.0)	(0.4)	(3.0)	(3.7)
2017	77.2	429.7	492.4	79.6	327.4	380.5
	(0.2)	(2.4)	(2.9)	(0.4)	(2.9)	(3.5)

Notes: Source: EES. Reporting real average monthly wages in Thousands of TSH. Standard errors in parenthesis. Wages are deflated using the Tanzanian CPI. All values are weighted by firm weight and the number of employees at the firm.

Table A.2: Sectoral Minimum Wages

Sector	National 2010 (1)	Minimum Wage 2013 (2)	Minimum Wage 2010 (3)	Increase (%) (4)
Health Services		132000	80000	65.0
Agricultural Services		100000	70000	42.9
Trade, Industries and Commercial Services				
Trade, Industry and Commerce		115000	80000	43.8
Financial Institutions	X	400000	80000	400.0
Communication Services				
Telecommunication Services		400000	300000	33.3
Broadcasting, Mass Media, and Postal Services	X	150000	80000	87.5
Mining				
Mining and Prospecting Licenses		400000	350000	14.3
Primary Mining Licences		200000	150000	33.3
Dealers Licenses		300000	250000	20.0
Brokers Licenses		200000	150000	33.3
Education	X	140000	80000	75.0
Domestic and Hospital Services				
Domestic Workers employed by Diplomats		150000	90000	66.7
Domestic Workers employed by entitled officers		130000	80000	62.5
Domestic Workers		80000	65000	23.1
Other domestic workers		40000	65000	-38.5
Tourists hotel		250000	150000	66.7
Medium Hotels		150000	100000	50.0
Restaurants and Bars		130000	80000	62.5
Private Security Services				
International security Companies		150000	105000	42.9
Private Security		100000	80000	25.0
Energy Services				
International Energy Companies	X	400000	80000	400.0
Energy Services	X	150000	80000	87.5
Transport Services				
Aviation Services		300000	350000	-14.3
Clearing & Forwarding		300000	230000	30.4
Inland Transport		200000	150000	33.3
Construction Services				
Contractor Class I	X	325000	80000	306.2
Contractors Class II-IV	X	280000	80000	250.0
Contractors Class V-VII	X	250000	80000	212.5
Fishing and Marine Services		200000	165000	21.2
Other sectors not mentioned above	X	100000	80000	25.0

Notes: Reporting nominal monthly minimum wages in Tanzanian Shillings for the 2010 and 2013 wage orders for each covered sector. National 2010 indicates sectors that were subject to the national minimum wage of 80,000 TSH in 2010 that were later covered in the 2013 revision. Sectors with minimum wages for subsectors are indented.

Table A.3: EES Firm Employment Summary Statistics

	min wage	wage	employees	casual	hires	female
	(1000 TSH)		% of total			(%)
	(1)	(2)	(3)	(4)	(5)	(6)
Agriculture						
2005-2007		123.1	4.3	23.9		29.8
2010-2013	70	317.4	3.9	31.9	2.6	30.2
2014 - 2017	100	413.2	4.1	25.1	3.9	22.0
Fishing						
2005-2007		105.9	0.2	0.5		18.3
2010-2013	165	262.2	0.3	0.4	0.0	13.5
2014 - 2017	200	173.7	0.2	0.4	0.0	9.7
Mining						
2005-2007		211.9	0.7	2.4		14.3
2010-2013	150	407.7	0.9	1.1	0.2	12.2
2014 - 2017	200	664.5	1.4	1.1	0.9	8.1
Manufacturing, Commerce, Trade						
2005-2007		196.8	14.6	43.7		23.0
2010-2013	80	236.2	21.7	41.2	16.6	24.2
2014 - 2017	115	356.0	25.1	37.2	13.7	19.3
Energy Services						
2005-2007		441.5	0.7	0.8		17.2
2010-2013	80	766.1	0.8	0.4	0.5	19.0
2014 - 2017	150	933.6	1.2	0.2	0.2	23.1
Construction						
2005-2007		394.5	1.7	5.7		17.2
2010-2013	80	331.0	2.1	5.0	1.2	15.9
2014 - 2017	250	493.9	2.2	7.0	1.6	8.4
Inland Transport						
2005-2007		199.8	1.2	0.3		9.3
2010-2013	150	350.1	1.5	0.9	1.1	13.0
2014 - 2017	200	419.2	1.5	1.4	1.8	7.8
Aviation Services						
2005-2007		323.9	0.2	0.1		24.6
2010-2013	350	534.6	0.1	0.1	0.0	38.9
2014 - 2017	300	1084.5	0.2	0.0	0.1	21.9
Clearing and Forwarding						
2005-2007		160.9	0.7	0.9		16.7
2010-2013	230	432.5	1.5	1.7	1.5	22.7
2014 - 2017	300	624.6	1.1	0.4	0.7	17.8
Hotels						
2005-2007		63.4	1.9	1.4		46.9
2010-2013	100	164.3	4.0	1.8	4.9	49.7

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EES Firm Employment Summary Statistics – *continued from previous page*

	min wage	wage	employees	casual	hires	female
	(1000 TSH)		(%) of total			(%)
	(1)	(2)	(3)	(4)	(5)	(6)
2014 - 2017	150	195.7	4.2	2.3	6.0	29.8
Restaurants						
2005-2007		105.4	2.0	1.8		54.7
2010-2013	80	163.1	3.7	2.5	4.0	56.8
2014 - 2017	130	188.8	2.7	1.4	4.4	27.1
Information Services						
2005-2007		250.4	1.2	1.1		42.9
2010-2013	80	447.0	0.8	0.2	0.3	38.7
2014 - 2017	150	585.8	1.0	0.6	0.6	25.1
Telecommunication Services						
2005-2007		340.2	0.6	0.1		29.5
2010-2013	300	795.1	0.6	0.0	0.4	32.0
2014 - 2017	400	824.3	1.1	10.6	0.9	24.7
Financial Services						
2005-2007		1542.1	3.2	0.2		40.8
2010-2013	80	842.7	2.1	0.1	2.6	42.9
2014 - 2017	400	1227.3	2.1	0.2	2.4	29.7
Private Security						
2005-2007		124.6	0.5	0.3		10.9
2010-2013	80	183.7	1.5	0.4	2.8	18.8
2014 - 2017	100	200.3	2.7	0.4	6.2	12.0
Education						
2005-2007		227.1	11.9	4.5		32.2
2010-2013	80	433.9	17.3	2.3	27.8	43.5
2014 - 2017	140	656.7	19.7	2.9	26.3	28.6
Health Services						
2005-2007		185.0	6.2	0.9		57.0
2010-2013	80	384.9	7.3	1.6	9.0	60.4
2014 - 2017	132	507.5	7.3	1.9	11.6	44.2
All Others						
2005-2007		281.4	48.4	11.4		31.9
2010-2013	80	436.2	29.7	8.3	24.4	34.9
2014 - 2017	100	640.6	22.2	7.1	18.6	24.4

Notes: Reporting the average values during each of the three periods. Columns(1) and (2) report the minimum wage and average monthly wage in thousands of Tanzanian Shillings. Columns (3)-(5) report the employment, casual employment, and hires as a percentage of the total. Column (6) reports the share of workers in that sector-period that are female.

Table A.4: EES Firm Size Summary Statistics

	min wage (1000 TSH) (1)	Firms Total (2)	employees (% of total) 5-49 (3)	50+ (4)	Private (%) (5)	Districts (6)
Agriculture						
2005-2007		1739	59.9	6.0	96.6	105
2010-2013	70	1090	70.1	15.2	85.5	111
2014 - 2017	100	1584	69.3	19.0	95.0	100
Fishing						
2005-2007		205	47.7	2.3	73.6	38
2010-2013	165	240	93.4	2.5	93.1	29
2014 - 2017	200	382	98.5	1.2	98.8	12
Mining						
2005-2007		262	78.7	9.8	78.2	45
2010-2013	150	161	81.7	17.0	97.2	29
2014 - 2017	200	508	77.4	15.0	97.4	60
Manufacturing, Commerce, Trade						
2005-2007		8345	66.1	4.3	87.4	104
2010-2013	80	15735	62.9	3.8	98.7	114
2014 - 2017	115	23876	61.9	4.3	98.9	124
Energy Services						
2005-2007		317	71.9	9.0	5.9	74
2010-2013	80	138	55.9	37.1	23.1	69
2014 - 2017	150	130	33.1	64.2	41.6	39
Construction						
2005-2007		942	76.2	4.0	82.7	69
2010-2013	80	1422	80.1	5.7	95.9	88
2014 - 2017	250	2182	85.2	6.0	98.2	67
Inland Transport						
2005-2007		493	51.6	7.8	70.6	40
2010-2013	150	837	73.4	6.3	95.7	42
2014 - 2017	200	1231	78.2	8.8	93.6	55
Aviation Services						
2005-2007		114	69.2	3.6	57.5	12
2010-2013	350	62	74.1	5.9	58.5	14
2014 - 2017	300	154	44.6	6.1	70.2	20
Clearing and Forwarding						
2005-2007		353	57.0	4.5	69.5	20
2010-2013	230	585	77.2	8.8	80.5	41
2014 - 2017	300	683	79.5	7.8	86.2	31
Hotels						
2005-2007		1975	66.4	1.9	99.2	74
2010-2013	100	4084	70.8	2.2	100.0	100

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EES Firm Size Summary Statistics – *continued from previous page*

	min wage (1000 TSH)	Firms	employees (% of total)		Private	Districts
		Total	5-49	50+	(%)	
	(1)	(2)	(3)	(4)	(5)	(6)
2014 - 2017	150	6707	68.5	2.7	100.0	113
Restaurants						
2005-2007		2924	70.3	0.2	99.3	56
2010-2013	80	5829	71.4	0.5	99.6	102
2014 - 2017	130	6994	74.5	0.4	100.0	105
Information Services						
2005-2007		2232	21.9	1.0	43.1	107
2010-2013	80	502	52.5	6.2	51.9	95
2014 - 2017	150	768	81.5	9.2	76.2	51
Telecommunication Services						
2005-2007		523	38.8	4.3	63.6	46
2010-2013	300	249	57.6	9.2	75.2	59
2014 - 2017	400	675	66.5	8.2	87.2	57
Financial Services						
2005-2007		2686	88.0	1.4	16.4	103
2010-2013	80	1269	66.3	4.5	59.4	89
2014 - 2017	400	2166	68.6	4.3	58.3	82
Private Security						
2005-2007		130	74.6	15.4	79.4	20
2010-2013	80	357	70.3	25.6	98.7	34
2014 - 2017	100	779	73.1	24.1	100.0	41
Education						
2005-2007		7263	82.5	3.0	16.9	116
2010-2013	80	3063	76.7	11.2	81.4	124
2014 - 2017	140	5080	76.9	13.9	81.3	123
Health Services						
2005-2007		2410	69.1	10.1	53.5	113
2010-2013	80	2480	64.6	13.7	86.6	123
2014 - 2017	132	3786	69.8	15.6	84.5	123
All Others						
2005-2007		25016	52.3	4.1	11.0	119
2010-2013	80	11230	57.6	8.6	50.0	123
2014 - 2017	100	14083	62.1	8.2	60.4	123
All						
2005-2007		57928	61.5	3.9	39.3	119
2010-2013		49332	65.5	6.1	83.6	124
2014 - 2017		71769	67.4	6.8	87.5	124

Notes: Reporting the average values during each year in each of the three periods. Column (2) reports the total number of firms in that sector-period. Columns (3)-(6) report the share of those firms with 5-49 employees, at least 50 employees and that are private, respectively. Column (6) reports the number of districts in which there are at least one firm in that sector operating in the sample.